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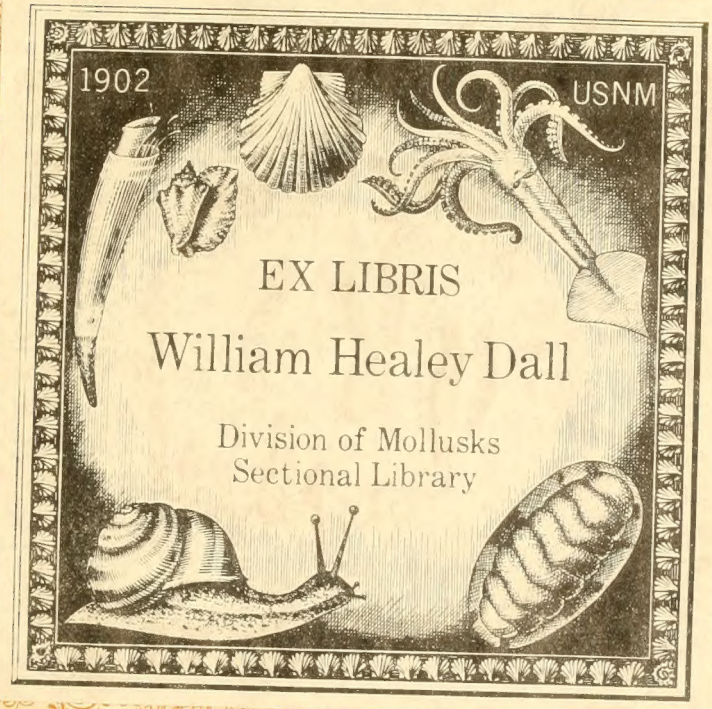
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THE CEPHALOPODA OF THE HAWAIIAN ISLANDS : : : : : By S. Stillman Berry

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THE CEPHALOPODA OF THE HAWAIIAN ISLANDS

By S. Stillman Berry

THE CEPHALOPODA OF THE HAWAIIAN ISLANDS.

By S. STILLMAN BERRY.

INTRODUCTION.

The ensuing monograph was originally projected as a report on the collection of cephalopod mollusks taken by the United States Bureau of Fisheries steamer *Albatross* during her Hawaiian cruise of 1902. It was found, however, that the pages required to be only slightly amplified to become practically a monographic survey of the entire Hawaiian region, and this has accordingly been done. Wherever possible a full description is given from Hawaiian material of each species under consideration. This is succeeded by a brief discussion of the further range of the species, tables of dimensions, a short critical comparison with other nearly allied forms, and such other items as seemed relevant. In some cases, especially where a species has been known to the writer only through the descriptions of other authors, it has been thought well to reprint the diagnosis of the original author in full. The work was commenced at Stanford University in the autumn of 1908, and, with the exception of the season of 1909–10, was prosecuted more or less continuously in the zoological laboratories there from that time to November, 1912.[a]

SOURCES OF MATERIAL.

The great bulk of the material upon which this report is based is the property of the United States Bureau of Fisheries and was obtained during the explorations of the United States Fisheries steamer *Albatross* on her extensive investigation in 1902 of the waters adjacent to the Hawaiian Islands, which constitute, zoologically speaking, what is known as the Hawaiian region. The principal part of the specimens have been turned over to the United States National Museum, but a set of the duplicates is deposited in the Stanford University collections.

I have further had for study the small series of shore forms already in the collections of Stanford University, most of them obtained by Dr. O. P. Jenkins during his visit to the islands in 1889, or by Dr. D. S. Jordan and Dr. B. W. Evermann in 1901. These

[a] As on a former occasion, I must express my gratitude to Dr. Walter Kenrick Fisher, of Stanford University, for the kindly interest with which he has constantly followed the progress of this work in his laboratory. It is of interest to note, also, that Dr. Fisher was a member of the *Albatross* staff during the Hawaiian explorations, and the occasional color and habit notes which appear in his handwriting on the labels of some of the specimens are of more than ordinary interest, especially when we consider how few data of the sort are available for even the commoner species of this group of animals.

To Dr. Harold Heath I am once more under obligation for the opportunity to work up an important collection originally placed in his own hands for study. It is also due to him that the series of drawings prepared by Mr. R. L. Hudson came into my hands at the same time with the specimens, so that the major portion of them could be utilized in the present report. Other illustrations in these pages are the work of Miss Lora Woodhead, Mr. Henry Varnum Poor, and Mr. John Howard Paine, all of Stanford University.

collections include one species (*Onychoteuthis banksii*) which was not taken by the *Albatross*.

In addition to the above there have constantly been available the collections of cephalopods made by the *Albatross* during the Alaska salmon investigations of 1903 and the dredgings off the California coast in 1904, together with the considerable series of west American and Japanese specimens owned by Stanford University. Although all of these have already been made the subject of reports (Berry 1912a, 1912b), their value for comparative study in the present consideration has been inestimable.

The type specimens of new species together with certain others have already been assigned catalogue numbers by the authorities of the National Museum, and such numbers are carefully cited in the proper paragraphs of the following pages. In referring to the Stanford University material, I have for the sake of brevity adopted the University initials—L. S. J. U.—immediately succeeded by a catalogue number which has reference to the invertebrate series in the University collections.

As will be seen, the material thus utilized lacks only *Polypus hawaiiensis*, *Symplectoteuthis oualaniensis*, and the clearly erroneous *Loligo gahi* and *Polypus fontanianus*, to embrace all the species known or reported from the islands, the great bulk of the records being nevertheless entirely new. The total number of specimens which I have personally examined is 210. These are distributed among 24 genera and include somewhat more than 29 species, only 4 of which have been previously recorded from the region. Some 15 of these species it has been found advisable to describe as new, and it is quite probable that several of the 10 or more forms represented by specimens too immature or too poorly preserved for accurate determination belong to species not yet described.

The *Albatross* collection has already formed the basis of two brief preliminary papers (Berry 1909, 1913), in which the majority of the new species were tersely described and in the first of which a provisional check list of all the species was also given.

HISTORICAL SURVEY.

With the exception of the two papers which have been just referred to as preliminary to the present report, no work specially devoted to Hawaiian Cephalopoda has ever been published. Even the scattered references contained in volumes of wider scope are not numerous and only to be found by dint of the most exhaustive searching. Despite its brevity, therefore, the following cursory survey of the literature is thought to be practically complete.

I have been unable to determine to what author belongs the honor of first bringing a Hawaiian member of our group to the public notice, since Gould in America and Souleyet in France both published in the same year. The latter author, reporting in 1852 on the mollusks taken during the voyage of the *Bonite*, describes only a single species from the islands, the *Octopus hawaiiensis*, a form which would naturally be expected to be abundant, but which has not been recognized with any certainty since.

In the magnificent memoir by Gould (1852) on the Mollusca of the Wilkes exploring expedition, two Hawaiian species are described for the first time, both of them common littoral forms, namely, *Octopus ornatus* Gould, and *Sepioteuthis arctipinnis* Gould.

In 1879 Tryon published a monograph of the Cephalopoda as the first volume of his Manual of Conchology. In addition to the three species just noted, two other forms are accredited to our region, namely, *Loligo gahi* d'Orbigny and *Polypus fontanianus* d'Orbigny. Both of these, however, are characteristic South American types and the Hawaiian record in each case seems almost certainly to be an error.

The *Challenger* steamed through the very heart of the region and made a brief call at Honolulu, yet took but a single species of cephalopod. This was a common reef *Polypus*, three specimens of which reached England and were there described by Hoyle (1885) as *Octopus marmoratus*.

In 1899 Schauinsland reported the occurrence of the following species in the neighborhood of Laysan Island, his identifications being based on determinations by Dr. G. Pfeffer:[a]

Octopus sp.	Ommastrephes oualaniensis.
Onychoteuthis Banksii.	Ommastrephes Sloanei.

In 1909 the present writer published preliminary diagnoses of seven supposedly new forms from the Hawaiian Islands, and as an appendix to the same paper added a simple check list of all the species known to occur in the region (Berry, 1909, p. 418). In this list some 22 species are named and 11 other forms are recorded without precise determination. This list, which follows herewith, should now be regarded as entirely supplanted by the present paper:

Cirroteuthis (?) sp.	Semirossia (?) sp.
Argonauta böttgeri.	Stoloteuthis iris n. sp.
Argonauta (argo?).	Sepioteuthis arctipinnis.
Tremoctopus (near quoyanus).	Ommastrephes sagittata near sloanei.
Alloposus mollis.	Ommastrephid (young).
Bolitæna sp.	Onychoteuthis banski.
Polypus hawaiiensis.	Symplectoteuthis oualaniensis.
Polypus hoylei n. sp.	Teleoteuthis appellöfi.
Polypus ornatus.	Abralia astrosticta n. sp.
Polypus marmoratus.	Abralia sp.
Polypus α.	Abraliopsis sp.
Polypus β.	Pterygioteuthis giardi.
Polypus γ.	Tracheloteuthis riisei.
Scæurgus sp.	Chiroteuthis famelica n. sp.
Stephanoteuthis hawaiiensis n. gen. and sp.	Cranchia (Liocranchia) globula n. sp.
	Cranchiid sp.
Euprymna morsei.	Helicocranchia fisheri n. sp.

Three years later Naef (1912, p. 247) proposed the new genus *Iridoteuthis*, basing it upon the Hawaiian *Stoloteuthis iris* Berry as its type and single known representative.

[a] Although fragmentary, Schauinsland's notes are of considerable interest, and in view of their inaccessibility to most students it may be worth while to repeat them here.

(P. 25) " . . . nicht selten hat man das Glück, hier auch einen der abenteuerlichen Tintenfische (Octopus) zu erbeuten, und zwar bisweilen in solcher Grösse, dass man sich vor seinen Saugarmen und scharfen Kiefern zu hüten hat."

(P. 92) "Neben den häufig bei Laysan sich findenden *Octopus*-Arten kommen dort an *Cephalopoden* (det. *Pfeffer*) noch vor: *Ommastrephes oualaniensis* Less. und *Omm. Sloanei* Gray, sowie *Onychoteuthis Banksii* Fér. Die drei letzten Arten bilden überwiegend die Nahrung der *Albatrosse*, wenigstens in der Zeit, in welcher sie ihre Jungen füttern. Die Exkremente derselben bestanden fast ausschliesslich aus Cephalopoden-Kiefern. Auch die *Sula*-Arten füttern anfangs ihren Nachwuchs mit verdauten Cephalopoden, später allerdings mit Fischen."

The same year a brief note was published by the writer (Berry, 1912b, p. 434) in which the Hawaiian *Ommastrephes* was awarded separate recognition as *O. hawaiiensis* n. sp. and a very brief definition given.

At about the same time (Berry, 1912c, p. 645) the identity of *Stephanoteuthis* with *Heteroteuthis* Gray 1849 having been recognized, the subsequent name was abandoned as a synonym (for this also see Naef, 1912, p. 246).

In 1913 the writer described the following new forms from the present material:

Lætmoteuthis lugubris n. gen. and sp.	Teleoteuthis compacta n. sp.
Scæurgus patagiatus n. sp.	Abralia trigonura n. sp.
Euprymna scolopes n. sp.	Pterygioteuthis microlampas n. sp.

In the present monograph all the species diagnosed in 1909 and 1913 are redescribed in better detail and figured throughout. Identifications corrected from the list of 1909, together with the few changes in nomenclature which have been found necessary since that time, will be made readily apparent by a glance at the following synopsis of the fauna. No additional new species are here described.

SYNOPSIS OF HAWAIIAN CEPHALOPODS.[a]

ORDER DIBRANCHIATA OWEN.
- SUBORDER OCTOPODA LEACH.
  - Family Cirroteuthidæ Keferstein.
    - Genus Laetmoteuthis Berry.
      - Laetmoteuthis lugubris Berry (2).
  - Family Argonautidæ (Cantraine).
    - Genus Argonauta Linné.
      - Argonauta böttgeri Maltzan (1+).
      - Argonauta sp. (1).
    - Genus Tremoctopus delle Chiaje.
      - Tremoctopus violaceus delle Chiaje (31).
  - Family Alloposidæ Verrill.
    - Genus Alloposus Verrill.
      - Alloposus mollis Verrill (1).
  - Family Bolitænidæ Chun.
    - Genus Eledonella Verrill.
      - Eledonella sp. (1)
  - Family Polypodidæ Hoyle.
    - Genus Polypus Schneider.
      - Polypus hawaiiensis (Souleyet) (0).
      - Polypus marmoratus (Hoyle) (13).
      - Polypus ornatus (Gould) (3).
      - Polypus hoylei Berry (4).
      - Polypus α (4).
      - Polypus β (15).
      - Polypus γ (4).
      - Polypus δ (1).
      - Polypus ε (2).
    - Genus Scæurgus Troschel.
      - Scæurgus patagiatus Berry (7).

[a] The number of specimens of each species examined is given in parenthesis after the specific name.

ORDER DIBRANCHIATA OWEN—Continued.

SUBORDER DECAPODA LEACH.

Division Myopsida d'Orbigny.

Family Sepiolidæ Keferstein.

Genus Euprymna Steenstrup.

Euprymna scolopes Berry (64).

Genus Stoloteuthis Verrill.

Stoloteuthis iris Berry (1).

Genus Heteroteuthis Gray.

Heteroteuthis hawaiiensis (Berry) (4).

Family Loliginidæ (d'Orbigny).

Genus Sepioteuthis de Blainville.

Sepioteuthis arctipinnis Gould (4).

Division Œgopsida d'Orbigny.

Family Onychoteuthidæ Gray.

Genus Onychoteuthis Lichtenstein.

Onychoteuthis banksii (Leach) (1).

Genus Teleoteuthis Verrill.

Teleoteuthis compacta Berry (1).

Family Enoploteuthidæ Pfeffer.

Genus Abralia Gray.

Abralia astrosticta Berry (1).

Abralia trigonura Berry (1).

Genus Abraliopsis Joubin.

Abraliopsis sp. (1).

Genus Pterygioteuthis Fischer.

Pterygioteuthis microlampas Berry (2).

Family Histioteuthidæ Verrill.

Histioteuthid, young (3).

Family Brachioteuthidæ Pfeffer.

Genus Brachioteuthis Verrill.

Brachioteuthis riisei (Steenstrup) (8).

Family Ommastrephidæ Gill.

Genus Ommastrephes d'Orbigny.

Ommastrephes hawaiiensis Berry (7).

Genus Symplectoteuthis Pfeffer.

Symplectoteuthis oualaniensis (Lesson) (0).

Genus Rhyncoteuthion Pfeffer.

Rhyncoteuthion α (11).

Rhyncoteuthion β (1).

Family Chiroteuthidæ Gray.

Genus Mastigoteuthis Verrill.

Mastigoteuthis (?) famelica Berry (1).

Family Cranchiidæ (Prosch).

Genus Liocranchia Pfeffer.

Liocranchia globulus Berry (3).

Genus Megalocranchia Pfeffer.

Megalocranchia fisheri (Berry) (1).

Genus Helicocranchia Massy.

Helicocranchia sp. (1).

CHARACTER AND RELATIONSHIPS OF THE HAWAIIAN FAUNA.

From the foregoing it will be seen that so far as is known the Hawaiian fauna includes about 25 named species of cephalopods, together with half as many more uncertain forms, some of which are doubtless worthy of recognition but which are only familiar to us by specimens either too young or too poorly preserved for a positive determination of the species. The total number of genera represented is 24, or about two-thirds as great as the total number of species. This is due to the fact that the genus *Polypus* with 9 forms listed (at least 5 of them doubtful), *Argonauta* with 2 species, and *Abralia* with 2 species, are the only genera which appear more than once in the list. (Owing to various facts which are to be summarized on another page, *Rhyncoteuthion* should obviously be excluded from the present discussion.) The apportionment of the fauna among higher groups is conveniently shown in the following table:

TABLE I.

Divisions.	Number of genera represented.	Named species.	Unnamed or doubtful species.
Octopoda	7	9	7
Myopsida	4	4	0
Oegopsida	13	11	5
Total	24	24	12

One very striking feature which is brought out with particular emphasis in such a table is the surprising weakness of the myopsid element in the fauna. Of the four myopsid genera, one is *Sepioteuthis*, the remaining three are *Sepiolidæ*, and even of each of these but a single species has come to hand.[a] The total absence of any representatives whatsoever of the great genera *Loligo* and *Sepia* in any of the collections was entirely unexpected. Of course Hawaiian species of one or both of these groups not improbably may yet come to light, but in any case I feel that the series of specimens collected by the *Albatross* is so representative that we may assert with confidence that neither genus attains any very great development in these waters, or even the prominence which we might reasonably expect when we consider what a dominant element they compose in the fauna of the Malaysian Archipelago as well as of Japan. *Loligo* especially is so abundant a genus and so cosmopolitan that it would be hazardous with our present knowledge to deny its occurrence anywhere. In the case of *Sepia*, however, it should be remembered that with the exception of a solitary and ill-authenticated record from the West Indies, not a single species is known from the waters adjacent to the American Continent nor indeed from the entire Western Hemisphere. The group being mainly a littoral one, we thus have *a priori* grounds for suggesting that wide oceanic areas may in some way form a special barrier to its dispersion. If this be true we should perhaps expect other littoral forms, such as the *Polypi*, to be distributed in accordance with the same principle; but this, as we shall see later, does not appear to be the case. An explanation of this anomaly may be found in the hypothesis that the dissemination of these other forms took place at a more ancient period. That the rise and dissemination of

[a] It should be remembered, however, that to one of these species, *Euprymna scolopes*, belongs the distinction of being by far the most abundant Hawaiian cephalopod. Nearly one-third of the total number of specimens examined are referable here.

the *Sepiidæ* actually is of comparatively recent occurrence receives distinct support from the circumstance that the dominion occupied by them is almost perfectly continuous and very symmetrically populated, with an extraordinarily rich development of species in the Indo-Malayan and Japanese regions, the apparent center of dispersion.

TABLE II.—DISTRIBUTION OF HAWAIIAN CEPHALOPODS.

Hawaiian species.	Bathymetric range.	Further distribution.	Bathymetric range.	Nearest analogue.	Distribution.	Bathymetric range.	Apparent degree of relationship.
	Fathoms.		*Fathoms.*			*Fathoms.*	
Lætmoteuthis lugubris.	258–284	.....	.....	(?)	.....	.....	
Argonauta böttgeri.	Surface.	Mauritius; Philippines; Australia.	Surface.	(?)	.....	.....	
Argonauta sp.....	Surface.	(?)	.....	Argonauta argo.	Mediterranean to Japan.	Surface.	(?)
				Argonauta pacifica.	Southern California to Galapagos Islands.	Surface.	(?)
Tremoctopus violaceus.	Surface.	Eastern Mid-Pacific; Indo-Malayan; Japan; Mediterranean.	Surface.	.....	.....		
Alloposus mollis....	286–290	North Atlantic..	197–715	Alloposus pacificus.	Japan.....	.....	Close.
Polypus hawaiiensis.	Shore.	.....	.....	(?)	.....	.....	
Polypus marmoratus.	Shore.	Ceylon, Rotuma, Amboina.	Shore.	Polypus bimaculatus.	Southern California to Panama.	Shore.	Fairly close.
Polypus ornatus....	Shore.	.....	.....	Polypus macropus.	Mediterranean; Indian Ocean; Japan.	Shore.	Fairly close.
Polypus hoylei.....	257–460	.....	.....	.....	.....	.....	
Scæurgus patagiatus.	127–178	.....	.....	Scæurgus unicirrus.	Mediterranean..	.....	Close.
Euprymna scolopes.	0–138	.....	.....	Euprymna stenodactyla.	Mauritius; South Pacific.	0–?	Very close.
Stoloteuthis iris.....	142–153	.....	.....	Stoloteuthis leucoptera?	New England...	94–388	Not very close.
Heteroteuthis hawaiiensis.	385–733	.....	.....	Heteroteuthis dispar.	Mediterranean..	500–700	Fairly close.
Sepioteuthis arctipinnis.	Shore.	.....	.....	Sepioteuthis lessoniana.	Red Sea to Japan and New Zealand.	.....	Close.
Onychoteuthis banksii.	Surface.	Cosmopolitan..	Surface.	.....	.....		
Teleoteuthis compacta.	385–733	.....	.....	.....	.....		
Abralia astrosticta..	192–352	.....	.....	Abralia steindachneri.	Red Sea.....	.....	Close.
Abralia trigonura...	306–308	.....	.....	Abralia andamanica.	Bay of Bengal...	188–320	Close.
Abraliopsis sp.....	Surface.	(?)	.....	Abraliopsis hoylei	Mascarene Island; west coast Middle America.	1200–2200	Close.
Pterygioteuthis microlampas.	314–335	.....	.....	Pterygioteuthis giardi.	Morocco; Indian Ocean; west coast of middle America.	551–1250	Close.
Brachioteuthis riisei	Surface.	Nearly cosmopolitan.	Surface.		.....		
Ommastrephes hawaiiensis.	220–312	.....	.....	Ommastrephes pacificus.	Japan.....	.....	Fairly close.
Symplectoteuthis oualaniensis.	.....	Red Sea to Japan; Australia; Cocos Is.	.....		.....		
Mastigoteuthis (?) famelica.	385–733	.....	.....	Chiroteuthis pellucida?	Bay of Bengal..	922	Fairly close (?).
Liocranchia globulus	Surface.	.....	.....	Liocranchia reinhardtii.	Atlantic; Indo-Malayan.	Surface.	Close.
Megalocranchia fisheri.	277–284	.....	.....	Megalocranchia maxima.	Cape of Good Hope.	.....	Close.
Helicocranchia sp...	230–277	(?)		Helicocranchia pfefferi.	Ireland.....	350	Fairly close.

This brings us to a consideration of the relationships of the Hawaiian cephalopod fauna with that of other regions and an inquiry as to which of the great Pacific areas can be brought most closely into correlation with it. In Table II (p. 263) I have endeavored to present in compact form a summary of the more essential data to which we must look for an answer to the question. Although admittedly our knowledge is still little more than fragmentary, certain facts seem to be brought out with sufficient prominence to demand consideration. Of the 24 named species listed in the first column, it will be seen that 16, or about two-thirds and including all but one of the shore species, are unknown from any other region. Two others may be eliminated from the discussion as being practically cosmopolitan. Another (*Symplectoteuthis oualaniensis*) occurs very generally throughout the Indian and Pacific Oceans. Of the remainder four are inhabitants also of the Indo-Malayan region. One species is shared with the north Atlantic, but this one (*Alloposus mollis*) appears to be of oceanic habit, so that a wide distribution is in a way to be anticipated.

It is evident therefore that we must turn to the species which are peculiarly Hawaiian in order to gain any proper idea of the true elements which enter into the composition of the fauna. In one of the succeeding columns of the table I have accordingly listed the species which appear to be most closely allied to these, and in yet another column the regions where such analogues are known to occur. The parallel with the Indo-Malayan fauna here appears very striking and again, as in the latter region, a very respectable assemblage of species possesses decided Mediterranean affinities. Indeed one genus, *Scœurgus*, is now known for the first time outside the bounds of the Mediterranean, and, although the species from the two sources appear to be separately nameable, they are nevertheless surprisingly close. *Heteroteuthis hawaiiensis* is another species which finds its nearest ally no nearer than the Mediterranean and here again the relationship is close. The widespread stock of *Polypus macropus*, which ranges in great abundance from the Mediterranean through the Red Sea, around southern Asia to the Malaysian Archipelago, and even to Japan, with practically no change in any of its characters throughout this entire area, also manages to reach the Hawaiian Islands, for it seems obvious that *P. ornatus*, though very distinct in itself, must have had its primary origin as an isolated outpost of this group. Of distinctly Indo-Malayan affinities, but not Mediterranean, are *Euprymna scolopes*, *Polypus marmoratus*, *Abralia astrosticta* (apparently near to *A. steindachneri* of the Red Sea), and perhaps *Mastigoteuthis*(?) *famelica*. *Polypus marmoratus* appears to be allied to the common *P. bimaculatus* of southern and Lower California, but aside from this somewhat anomalous example the fauna has little in common with that of western America.[a]

With the Japanese fauna likewise, outside of the invading Indo-Malayan element shared by both, the Hawaiian cephalopods exhibit no particular relationship. *Ommastrephes hawaiiensis* is doubtless to be regarded as an offshoot of the same stock which gave

[a] So little is at present known regarding the teuthology of the south Pacific that the Australian region has not here been considered as separate from the Indo-Malayan, although the reported presence of *Dosidicus gigas* in those waters would tend to show a certain relationship with the South American fauna.

origin to *O. pacificus* (and *sloanii* ?), and *Sepioteuthis arctipinnis* is similar or identical with *S. lessoniana*, but without exception all the species most truly characteristic of the one area are conspicuous only by their absence in the other. We are able to correlate at least a portion of the Japanese fauna with that of western North America much more successfully.

In summing up, then, it may be said that, although the ensemble of Hawaiian cephalopods shows many features peculiar to itself, it appears reasonable to regard it as an offshoot, now largely isolated, of the great Indo-Malayan fauna, and therefore impossible of any definite or satisfactory correlation with that of other regions of the north Pacific. That this statement is in substantial accord with the conclusions reached by students of other groups of animals is readily seen by a glance at almost any of the monographs dealing particularly with the fauna of the archipelago.

Nutting (Bulletin U. S. Fish Commission, vol. xxiii, for 1903, p. 934, 1906) in discussing the hydroids says that they "have unmistakable relationship with the Australian region," although (p. 935) "as would be expected from the isolated position of the Hawaiian Islands, the preponderance of peculiar species is very exceptionally large."

Miss Rathbun reaches similar conclusions from a study of the decapod crustaceans. She says that "the Hawaiian fauna is almost entirely Indo-Pacific, the islands forming the northeastern, as the Indian Ocean is the southwestern, limit for the majority of the species" (t. cit., p. 830, 1905). She finds but few species peculiar to the islands, however.

Fisher (t. cit., p. 999, 1906) finds the distribution of the starfishes indicative of entirely similar phenomena. He writes that "we are at once struck by the fact that the Hawaiian fauna bears more resemblance to that of the distant Indian region than it does to the fauna of America, notwithstanding that all the ocean currents which pass the Hawaiian Islands are coming from America and not from the west."

In the case of the shore fishes Jordan and Evermann (t. cit., p. 32, 1905) have found the fauna to be "frankly and entirely tropical, all the species belonging to genera characteristic of the tropical Pacific," but most of the species themselves seem to be peculiar to the islands.

The conclusions of Gilbert (t. cit., p. 578, 1905), after his critical examination of the deep-sea fishes collected by the *Albatross*, are especially full of interest: "An analysis of the list of species recorded in the present paper shows conclusively that the bathybial fishes of Hawaii, like those of its reefs and shores, have been derived as a whole from the west and south, and not from the east or north. In its entire facies, the fauna is strikingly unlike that of the Pacific coast of Mexico and Central America, and resembles strongly the assemblage of forms discovered by the *Albatross* and the *Challenger* off the coasts of Japan and the East Indies. Some of its members find their nearest known affines in the Bay of Bengal."

On the other hand, Mayer (t. cit., p. 1133, 1906) in his report on the Medusæ writes that "it appears the majority of the Hawaiian forms are of wide distribution," a conclusion entirely harmonious with what we know regarding such cephalopods as are of similar habit.

BATHYMETRICAL DISTRIBUTION.

The data accompanying the lists of specimens taken by the *Albatross* as given in this paper are partial extracts from the records of the voyage as given in the Report of the United States Fish Commission for 1902 (p. 397–432, Washington, 1903). For more full and detailed stational observations reference may be had to the original paper.

It is worthy of note that no truly abyssal forms were captured unless we so consider the two specimens of *Lætmoteuthis*, the mangled condition of which may perhaps be partly due to their having gotten considerably "out of their depth" when taken, as well as to rocks in the dredge. A glance at the table of stations given in the appendix of this report shows that the greatest depths from which any specimens of cephalopods were obtained were those sounded at stations 3989 (385–733 fathoms, *Heteroteuthis hawaiiensis*, *Teleoteuthis compacta*, *Mastigoteuthis* (?) *famelica*), 4039 (670–697 fathoms, *Eledonella* sp.), and 4110 (449–460 fathoms, *Polypus hoylei*). In no other instances was a member of the class obtained at a greater depth than 400 fathoms, and even in the cases above cited it seems by no means improbable that some of the actively nectonic species may have become ensnared in the dredge during its transit to the surface. Altogether it must be admitted that even the archibenthal regions have been scarcely drawn upon, and it is only concerning the reef and pelagic fauna that we can presume even a fair degree of knowledge. The two latter habitats have each their characteristic group of species, although certain of the smaller free-swimming forms are not uncommon in the reef pools, and both attain the richness customary in tropical regions. As is well known in the case of the fishes and other groups, many of the reef species are truly regal in their brilliantly variegated coloring and other ornamentation. *Polypus* entirely fulfills expectations in being the group most conspicuous on the reefs both in species and in number of individuals, but *Euprymna* and *Sepioteuthis* are also to be captured there. In the plankton we find the usual run of more delicate, less actively swimming forms—*Argonauta*, *Tremoctopus*, *Trachelioteuthis*, larval ommastrephids, histioteuthids, and octopods of various species and genera, *Liocranchia*, and the omnipresent *Euprymna*—nearly all warm-water species of wide dispersion.

As is shown in the table following, five species, mainly of very active habit, are found between the surface and the 100-fathom mark, the richest and by far the most varied fauna of all occurring in the deeper water down to a depth of 400 fathoms. The most remarkable bathymetric range exhibited by any single species is that of *Euprymna scolopes*, which, though very abundant at or near the surface, is frequently met with in all depths down to 130 or 140 fathoms and therefore appears in no less than four columns of the table. *Polypus hoylei* is recorded from 257 to 460 fathoms.

TABLE III.—BATHYMETRIC DISTRIBUTION OF HAWAIIAN CEPHALOPODS.

Shore.	Surface.	Surface to 100 fathoms.	100 to 500 fathoms.	Over 500 fathoms.
OCTOPODA.	OCTOPODA.	OCTOPODA.	OCTOPODA.	OCTOPODA.
Polypus hawaiiensis. Polypus marmoratus. Polypus ornatus. Polypus γ. Polyphus δ.	Argonauta böttgeri. Tremoctopus violaceus. Polypus α. Polypus β. Polypus γ.	Polypus ε.	Laetmoteuthis lugubris. Alloposus mollis. Polypus hoylei. Polypus ε. Scæurgus patagiatus	Eledonella sp.
DECAPODA.	DECAPODA.	DECAPODA.	DECAPODA.	DECAPODA
Sepioteuthis arctipinnis. Euprymna scolopes.	Euprymna scolopes. Onychoteuthis banksii. Abraliopsis (young). Histioteuthid (young). Brachioteuthis riisei. Rhyncoteuthion α. Rhyncoteuthion β. Liocranchia globulus.	Euprymna scolopes Onychoteuthis banksii. Ommastrephes hawaiiensis. Symplectoteuthis oualaniensis.	Euprymna scolopes. Stoloteuthis iris. Heteroteuthis hawaiiensis. Teleoteuthis compacta. Abralia astrosticta. Abralia trigonura. Pterygioteuthis microlampas. Ommastrephes hawaiiensis. Mastigoteuthis (?) famelica. Megalocranchia fisheri. Helicocranchia sp.	Heteroteuthis hawaiiensis (?) Teleoteuthis compacta(?) Mastigoteuthis(?)famelica(?)

COMPARATIVE ABUNDANCE.

The comparative abundance of the different species in the collection is readily appreciated by a glance at the figures appended to the synopsis on page 260. It is remarkable that out of a total of 210 specimens examined, 64, or nearly one-third, are *Euprymna scolopes*. Of the remainder, 31, or nearly one-sixth of the total, are *Tremoctopus violaceus;* 15 are the immature *Polypus* designated as β; 13 are *Polypus marmoratus;* eleven are the larval ommastrephids known as *Rhyncoteuthion;* 8 are *Brachioteuthis riisei*, while *Scæurgus patagiatus* and *Ommastrephes hawaiiensis* are represented by 7 specimens each.

The most notable catch of cephalopods made by the *Albatross* in any single haul was in the surface nets at station 3926, between Oahu and Laysan Islands, where 11 specimens representing 1 species each of no less than 5 genera were obtained.

LOCAL DISTRIBUTION.

Regarding the distribution and relative frequency of the littoral and shallow-water species among the respective islands of the archipelago, little or nothing can be said at the present time. As would be expected, most of the collecting has been done on Oahu in the neighborhood of Honolulu; a few specimens have occasionally come to hand from Maui, but almost nothing from the other islands. The remote islands of the Midway Group ought to prove particularly interesting in this respect, since their oceanic extent is large and we are completely ignorant concerning the cephalopods of their littoral fauna.

CLASSIFICATION AND NOMENCLATURE.

In conformity with my "Review of the Cephalopods of Western North America" (Berry, 1912a) I have followed the general lines of cephalopod classification laid down in the various works of Hoyle, with certain modifications adapted from Pfeffer's "Synopsis" (1900) and the masterly monograph of the *Valdivia* Œgopsida by Chun (1910). The present material has afforded few bizarre forms and, although highly important from a distributional and local standpoint, accomplishes very little toward the elucidation of the wider evolutionary problems. Of decided importance, however, is the discovery of an otherwise typical member of the family *Cirroteuthidæ*, which is remarkable not only for being the second species in the entire group known to possess an odontophore, but also for its apparently total lack of the alternating rows of cirri along the arms, hitherto thought to be a characteristic as invariable as it is puzzling. The occurrence of a Pacific *Scœurgus* and a new sepiolid having affinity with the Atlantic *Stoloteuthis leucoptera* is also noteworthy. The presence in the collection of a large series of young ommastrephids comprising at least two *Rhyncoteuthion*-like forms specifically distinct from one another indicates that the occurrence of the curious *Rhyncoteuthion* stage is an exceedingly widespread ontogenetic character in this family and one by no means confined to the typical genus.

The primary division of the Dibranchiata of Owen into the Octopoda (devilfishes) and Decapoda (squids[a]), as proposed by Leach in 1817, is here adhered to, although the latter term is very confusing in view of the prior use of the name for a well-known group of Crustacea (Decapoda Latreille 1806). In many respects the restoration of Blainville's Octocera and Decacera would be much more satisfactory, an excuse for discarding the complementary term Octopoda being possibly available because of the existence of Octopodia Schneider 1784, which was proposed as a general term for the entire class over a decade before Cuvier called them Cephalopoda.

I have found myself quite unable to accept the various major divisions into which some authors have grouped the Octopoda, but on the other hand I have been unable to formulate any more natural arrangement of my own which could be utilized in their stead. In regard to the Decapoda, however, the anciently recognized bifurcation into Myopsid and Œgopsid forms seems very convenient and on the whole a natural separation. Chun's further division of the latter group into Œgopsida libera and Œgopsida consuta appears to me cumbersome and but little superior to the nearly or quite synonymous Teuthidea and Taonidea of Verrill. For the purposes of the present paper it is not, however, necessary to adopt either system.

In the arrangement of the families themselves scarcely any two authors are in entire agreement, so that the sequence herein followed can be regarded as in no way more than provisional.

A word should be said in regard to the sort of morphological characters chiefly depended upon by the author in distinguishing species; that is, beyond such conspicuous differences in bodily structure and general form as obviously require no explanation

[a] In the Hawaiian Islands the term "squid" is colloquially employed to include nearly all cephalopods, especially the edible forms such as *Polypus*, even though the usage is not scientific nor accurate English.

or apology even to the layman. This is particularly needful concerning the Octopoda, as in this group it is often very difficult to lay down on paper a hard and fast line respecting a given character which will invariably serve to separate a species from some other perhaps very closely allied. Here, in the absence of direct comparison between specimens, a sort of average of the entire physiognomy is largely depended upon, taking into consideration the relative length of the arms, the shape and extent of the umbrella, the presence or absence of ornamental processes of various sorts upon the integument, and the more evident conditions of preservation, which frequently affect the features already stated to a degree which can scarcely be too strongly emphasized. When the specimens are males, however, the structure of the hectocotylized arm is variously modified, usually constant in its peculiarities, and hence a criterion of the highest importance; perhaps no other single feature so well maintains its value in preserved material. I am also inclined to treat with respect any decided peculiarities of color, particularly when the various pigments appear to be disposed after the manner of a definite pattern. Frequently the so-called "funnel organ" exhibits tangible modifications in shape, though whether these latter are more valuable than confusing as a key to interrelationship is not yet apparent.

Among the Decapoda some of the above-mentioned features are of very minor specific significance. Here I have frequently given considerable weight to relatively minute differences in the form and arrangement of the suckers (or hooks) on the sessile arms and more particularly, on the terminal clubs of the tentacles, as these characters, even though small, are definitely to be apprehended and usually little affected by the action of the preserving medium. Nevertheless, there is certainly need for a greater quantity of comparative data showing the range of variation in these organs and until this is available there is constant danger that too much emphasis has been placed upon their details. Among the luminous forms, particularly the Œgopsida, the arrangement and structure of the photogenic organs is nearly always subject to important modification, both specific and generic or even of higher significance. The funnel organ appears to be of less practical systematic value in the Decapoda than in the Octopoda, for although it undergoes considerable modification among different genera (particularly the various Cranchiidæ), the differences between those of closely allied species are apt to be too slight to be appreciable.

On account of their easy preservation as "hard parts," the gladius and radula have occupied a dominant position in the schemes of classification of many of the older authors as well as a few of the more recent ones, but the undesirable mutilation of the specimen entailed by their examination, coupled with the writer's belief that their relative importance has been greatly overrated, has in the present work prevented their receiving the attention to which they are perhaps more justly entitled. Other "hard parts" which are ofttimes very useful to observe are the horny rings which arm the apertures of the suckers in most if not all Decapoda and which often show interesting modifications, chiefly depending upon the varying degrees of smoothness or denticulation of their outer margins.

Wherever a specimen appeared to possess definable characters of its own, however minute, the present writer has ranked himself frankly with the "splitters," especially in cases where the nearest known ally of such a form has been described from a far distant region. This procedure has not been resorted to from any desire to describe "new species," but because of a conviction that wherever a given animal from a definite locality can be referred to a previously named species only with considerable doubt, the exigencies of systematic zoology are much better to be subserved by the provisional use of a separate name. To many a student of geographical distribution the possible evil of one more synonym does not seem nearly so repugnant as the improper listing of a species, through imperfect or incorrect knowledge of its totality of characters, from a region where it does not (often even remotely) belong.

In matters of taxonomy the writer has unreservedly sought strict literal obedience to the published rules of the International Commission for Zoological Nomenclature. Thanks to the careful work of previous authors, notably Hoyle, this procedure has not resulted in the demolition of very many teuthologic landmarks. It is possible that additional changes ought in some instances to be made, but wherever any given case did not clearly appear to be governed by some definite rule in the code, the current prevailing usage was adhered to.

It might be well to call attention to the fact that in the verbal orientation of specimens for purposes of description, the terms anterior and posterior, dorsal and ventral have been used in their usual physiological sense (i. e., with relation to the normal activities of the adult animal) rather than in their strict morphological (and embryological) significance, which latter would necessarily result in a more complete reformation of the current anatomical nomenclature than could well be attempted at the present time. It must be admitted, however, that to the student of molluscan comparative anatomy recourse to a system of topographic names based on the latter system would have much to commend it.

ECONOMIC IMPORTANCE.

In the Hawaiian Islands, as in most other maritime countries, the common littoral cephalopods form a very important source of food. Both *Polypus* (particularly *P. marmoratus* and *ornatus*, to judge from the market specimens before me) and *Sepioteuthis* are frequently offered for sale in the Honolulu markets. The Hawaiian word denoting the *Polypus*, and perhaps other forms as well, is "hee." Cobb (1905, pp. 734, 736, 740) gives the following interesting account of some of the various modes of procedure resorted to by the natives for their capture:

> Spears are frequently used in fishing for the hee (octopus), principally by women. This animal generally makes its home in small circular holes in the rocks on the reefs. When the fisherwoman finds a hole that she thinks is occupied she runs the spear into it gently. Should a hee be there it comes out to see what is the matter, the spear is run through it, and it is brought to the surface. The woman usually carries a smaller spear also, and with this she pricks or hits the animal in the head until it is stunned or killed, otherwise it might twine around her arms or legs and cause serious difficulty.
>
> * * * * * * *

In fishing for hee (octopus) the native dives to the bottom, and, with a stick, pokes around in the small holes in which the animal lives. When he touches one it seizes the stick and allows him to draw it out of the hole. On reaching the surface the native seizes his captive with his hands and bites into its head, thus killing it.

* * * * * * *

The native is a great lover of the hee and has a number of methods of capturing it, one of the most interesting of which is with the cowrie shell. One or more cowrie shells of the Mauritiana or Tiger varieties are attached to a string. When only one is used, an oblong pebble about the size of the shell is tied to the face of it, a hole is pierced in one end of the back of the shell, a line is passed through, and after being fastened here, allowed to hang a few inches below the shell, to which a hook, whose point stands almost perpendicular to the shaft or shank, is attached. Only shells with small red spots breaking through a reddish-brown ground have an attraction for the hee, and it will not rise to any other kind. Shells which have suitable spots but unsuitable background are given the desired hue by steaming them over a fire of sugar-cane husks.

On arriving at the fishing ground the fisherman in pursuit of hee either chews up and spits upon the water a mouthful of candlenut meat, to render the surface glassy and clear, or he uses the water glass, which is described below. He drops the shell into the water, and by means of the line swings it back and forth over a place likely to be occupied by a hee. The greedy animal perceives the shell, shoots out an arm, and seizes it. If the bait is attractive, after a few moments' hesitation another arm is placed around it, and then another, until at last the animal withdraws itself entirely from its hole and hugs the shell closely to its body, oblivious of everything else. The fisherman then draws it rapidly up through the water, and when it raises its head at the surface, pulls it over against the edge of the canoe and delivers a blow between the eyes with a club which is generally fatal. Owing to the hee's quickness with its eight tentacles or arms, the fisherman has to be very rapid in his movements, as the animal would be no mean antagonist should it have an opportunity to seize him with its arms. The natives say that a number of persons have lost their lives in struggles with the octopus. This method of fishing is called by the natives "Lawaia hee me ke leho" (squid catching with cowrie).

Nearly all squids and a good many octopods possess a further economic value in that they comprise one of the chief articles of diet for such birds as the albatross and shearwater, as well as for many of the more important food fishes.

KEY TO THE CEPHALOPODA KNOWN TO INHABIT THE HAWAIIAN ISLANDS AND ADJACENT WATERS.

I. Arms normally eight in number, tentacles being absent; suckers sessile, without a horny ring (OCTOPODA).

1. A pair of lateral oar-shaped fins present; suckers in a single row. (Family Cirroteuthidæ.)

2. Radula present; suckers not flanked by paired cirri.....*Lætmoteuthis lugubris*, p. 275.

1′. No fins.

3. Hectocotylized arm of male involving the entire third arm of one side, developed in a specialized sac, and separable at maturity; animals pelagic. (Family Argonautidæ.)

4. Dorsal arms of female with terminal winglike expansions modified for the secretion of an external "shell;" left third arm of male hectocotylized; no aquiferous pores present on head. (Genus *Argonauta*.)

5. Shell relatively small, compactly coiled, without auricular expansions at sides. *Argonauta böttgeri*, p. 277.

5′. Shell large, more or less auriculate at the sides.....*Argonauta* sp., p. 280.

4′. Dorsal arms of female connected by a broad velum, but without terminal expansions; no external shell; right third arm of male hectocotylized; aquiferous pores present on head. *Tremoctopus violaceus*, p. 281.

3′. No aquiferous pores; no external shell; dorsal arms normal.

6. Body soft and gelatinous; suckers in two rows; hectocotylus of male involving entire right third arm, which is presumably separable..... *Alloposus mollis*, p. 287.

6′. Body soft; suckers in a single row; hectocotylized arm not separable (family *Bolitænidæ*)..... *Eledonella* sp., p. 289.

6″. Body comparatively firm; suckers in two rows; hectocotylus of male confined to tip of one third arm, to which it forms a spoon-shaped extremity. (Family Polypodidæ.)

7. Hectocotylus affecting third arm of right side. (Genus *Polypus*).

8. A conspicuous pigmented oculation obliquely in front of each eye; hectocotylus minute..... *Polypus marmoratus*, p. 291.

8′. No definite ocular markings in front of the eyes.

9. Adult brightly colored, the pigment conspicuously arranged in longitudinal bands or series of spots; arms very long and attenuate... *Polypus ornatus*, p. 294.

9′. No definitely arranged color pattern.

10. Body smooth, without cirri; second arm pair longest; color dark. *Polypus hawaiiensis*, p. 290.

10′. Body finely papillose, rather soft, with blunt cirri over the eyes; mantle opening small; color uniformly pale..... *Polypus hoylei*, p. 296.

7′. Hectocotylus affecting third arm of left side; body bounded by a conspicuous peripheral fold..... *Scæurgus patagiatus*, p. 305.

II. Arms normally 10 in number, one pair being greatly modified to form the "tentacles"; suckers distinctly pedunculate, their apertures usually bounded by a chitinous ring (DECAPODA).

1. Eyes covered by a continuous membrane (division Myopsida).

2. Adult small; body short, rounded posteriorly, with round or ovate lateral fins; gladius much reduced or wanting. (Family Sepiolidæ.)

3. Dorsal margin of mantle fused with head in nuchal region.

4. Fins of moderate size; suckers in four rows on the arms and 16 or more on the tentacle club; left dorsal arm hectocotylized..... *Euprymna scolopes*, p. 312.

4′. Fins very broad and longer than the mantle; suckers on the arms in two rows; a conspicuous shield-shaped patch on the ventral surface of the mantle..... *Stoloteuthis iris*, p. 316.

3′. Dorsal margin of mantle free; funnel covered by a conspicuous forward prolongation of the mantle..... *Heteroteuthis hawaiiensis*, p. 319.

2′. Adult relatively large; body elongate, pointed posteriorly; fins marginal, extending the entire length of the mantle; gladius well developed, its texture horny throughout. *Sepioteuthis arctipinnis*, p. 308.

1′. Eyes with a perforated lid (division Œgopsida).

5. Part of the suckers with their chitinous rings transformed to hooks.

6. Sessile arms with true suckers only; one or more rows of hooks on tentacle club.

7. Adult moderately large; two rows of hooks on the tentacle club. *Onychoteuthis banksii*, p. 322.

7′. Adult small; hooks and suckers of tentacle club in four rows. *Teleoteuthis compacta*, p. 324.

6′. Sessile arms with part of the suckers modified into hooks. (Family Enoploteuthidæ.)

8. All suckers of sessile arms modified into hooks except at the extremity; hooks also present on tentacle club; ventral surface of mantle ornamented with numerous photogenic organs.

9. Buccal membrane pale in color; tips of ventral arms normal.

10. Photophores of mantle distinctly of two types and showing a definite bilateral arrangement; fins comparatively small..... *Abralia astrosticta*, p. 326.

10′. Photophores not conspicuously differentiated into two main types; their bilateral arrangement obscure; fins half as long as the mantle.
Abralia trigonura, p. 329.

9′. Buccal membrane dark reddish or violet in color; ventral arms with a series of three conspicuous heavily pigmented beadlike organs at their tips.
Abraliopsis sp., p. 331.

8′. Tentacle club with suckers only, but few hooks on sessile arms; numerous photogenic organs on the eyeball and within the pallial cavity, but none on the outer aspect of the mantle.....*Pterygioteuthis microlampas*, p. 332.

5′. None of the suckers with their chitinous rings transformed to hooks.

11. Mantle free all round anteriorly (not true of *Symplectoteuthis*, as see below).

12. Numerous photogenic organs on the body, head, and arms. (Family Histioteuthidæ), p. 335.

12′. Photogenic organs few in number or absent.

13. Funnel articulating with the mantle by a ⊥-shaped groove. (Family Ommastrephidæ.)

14. Sucker bearing portion of tentacles greater than half the total length; fixing apparatus poorly developed. *Ommastrephes hawaiiensis*, p. 338.

14′. Sucker bearing portion of tentacles less than half the total length.

15. Mantle fused with the funnel on at least one side; fixing apparatus a distinct carpal group of pads and suckers.
Symplectoteuthis oualaniensis, p. 341.

15′. Animal small; clubs of tentacles fused to form an X-shaped or proboscis-like organ.....*"Rhyncoteuthion"*, p. 341.

13′. Funnel articulating with the mantle by a simple pit or groove.

16. Mantle delicate, membranous, transparent; fins sagittate; pelagic.....*Brachioteuthis riisei*, p. 336.

16′. Mantle fleshy, produced to a delicate point posteriorly; fins lanceolate, over half as long as the mantle; ventral arms much the longest.....*Mastigoteuthis* (?) *famelica*, p. 344.

11′. Mantle fused with the funnel on either side and with the head in the nuchal region; mantle ample, thin, transparent; viscera confined to a very small proportion of the pallial cavity. (Family Cranchiidæ).

17. Mantle ornamented with several series of cartilaginous tubercles; mantle greatly inflated..*Liocranchia globulus*, p. 346.

17′. Mantle smooth; only moderately inflated.

18. Eyes enormous, rounded, sessile. *Megalocranchia fisheri*, p. 348.

18′. Eyes much smaller, oval, upon short stalks.
Helicocranchia sp., p. 350.

NOTE.—Except in the case of one or two well-known and widely distributed species, it has been my endeavor in the following pages to make the list of references preceding the description of each species as nearly complete as possible, and it is hoped that the occasional parenthesized comments regarding the nature of particular citations will prevent the confusion which might otherwise accrue through the promiscuous cataloguing of trivial and important references in the same tables. An attempt has been made to economize the time of the reader by printing all citations of special present importance in bolder type than the remainder.

Phylum MOLLUSCA.

Class CEPHALOPODA Cuvier 1798.

Octopodia Schneider 1784, p. 108.
Cephalopoda Cuvier 1798 (*fide* Gray).
Cephalopodia Rafinesque 1815, p. 139 (*fide* Binney and Tryon, p. 14).
Cephalophora de Blainville 1825, p. 364.

Order DIBRANCHIATA Owen 1836.[a]

Antepedia Rafinesque 1815, p. 139 (*fide* Binney and Tryon, p. 14).
Cryptodibranchiata de Blainville 1824, p. 172 (*fide* Verrill).
Acétabulifères d'Orbigny 1835, p. 1.
Dibranchiata Owen 1836, p. 127.
Acetabulifera d'Orbigny 1845, p. 157.
Antepedia Gray 1849, p. 2.
Dibranchia Pelseneer 1906, p. 336.

Arms eight or (inclusive of the tentacles when present) ten in number; furnished with longitudinal rows of acetabulæ or suckers along their inner surfaces. Funnel a closed tube. Normally but a single pair each of ctenidia and renal organs present. Visceral mass naked; shell much reduced and embedded in the tissues of the mantle, frequently absent. Eyes highly developed and with closed cavities; a crystalline lens present. Characteristic and intricately constructed dermal pigment cells called "chromatophores" are developed in the integument.

This order includes all living cephalopods except *Nautilus*.

Suborder OCTOPODA Leach 1817.

Octopia + *Argonautea* Rafinesque 1815, p. 139 (*fide* Binney and Tryon, p. 14).
Octopoda Leach 1817, *fide* Gray.
Octocera de Blainville 1824 (*fide* Verrill); 1825, p. 365.
Octopoda d'Orbigny 1845, p. 163.
Octopia Gray 1849, p. 2, 3.
Octopoda Verrill 1881, p. 360.

Arms normally always eight in number and similar (with the exception of the hectocotylized arm in the male); tentacles absent. Suckers sessile, usually with thickened bases; their apertures not equipped with horny or chitinous rings. Body usually short; always rounded posteriorly; finless, or rarely with one or two pairs of weak oar-shaped lateral fins. Head and mantle broadly continuous in the nuchal region. Cœlom greatly reduced. No gladius. Wherever hectocotylization occurs it is one arm of the third pair which is affected. With the exception of the recently described *Melanoteuthis* Joubin 1912, specialized photogenic organs are unknown in the entire suborder.

Family CIRROTEUTHIDÆ Keferstein 1866 em.

Pteroti Reinhardt and Prosch 1847, p. 38.
Cirrhoteuthidæ Keferstein 1866, p. 1447.
Cirrhoteuthidæ Verrill 1881, p. 382.
Cirroteuthidæ Hoyle 1904, p. 3.

Adult animals commonly of large size. Body equipped with one or sometimes two pairs of lateral oar-shaped fins. A well-developed internal skeleton, comprising a broad saddle-shaped or horseshoe-shaped dorsal cartilage and a few lesser elements. Suckers in a single row which usually alternate with two flanking rows of paired cirri. Radula usually absent.

Genus LÆTMOTEUTHIS Berry 1913.

Laetmoteuthis Berry 1913, p. 563.

Adult of large size. Body rounded, with a small, weakly supported, transversely elongate fin attached to either side of the mantle. Arms moderately long; connected for the greater part of their length by an ample umbrella; intermediate web lacking. Suckers large, little elevated, in a single slightly zigzag row; paired cirri absent, or at best greatly reduced (possibly confined to the tips of the arms). Radula neither wanting nor reduced, but generously developed and with seven rows of teeth.

[a] Date often given as 1832, but the paper upon which such quotation is based is unknown to me.

Type.—Lætmoteuthis lugubris Berry 1913, a species of the Hawaiian Islands.

The genus is closely allied to both *Cirroteuthis* and *Stauroteuthis*, but differs in the absence of paired cirri and the presence of an odontophore.

Lætmoteuthis lugubris Berry 1913. (Pl. XLIX, fig. 1, 2.)

Cirróteuthis (?) sp. Berry 1909, p. 418 (mere record).
Lætmoteuthis lugubris Berry 1913, p. 563.

Body large, rounded posteriorly. Lateral fins situated well back on the mantle, but small, transversely elongate, their greatest dimension (width) about twice as great as their length (fig. 2). Funnel thin walled, very large and broad; interior ample. Eyes probably large.

Arms long, appearing merely as thickenings or soft folds in the broad and ample umbrella and without any intermediate web connecting them thereto. Umbrella longest between the ventral arms, but everywhere extensive though very thin. Suckers large, flattened, distant; in a single series, though frequently somewhat zigzag; slightly, but not much, firmer in texture than the arms or umbrella; round-tubercular in shape; the apertures contracted, their margins crenulate. Paired cirri indistinguishable.

Mandibles large, compressed; but, with the exception of the sharp powerful beaks, thin and comparatively fragile; color black, horny at margin. (Pl. XLIX, fig. 1, 2.)

A very large and perfectly developed radula present; of the seven rows of teeth the tricuspid medians are considerably the largest.

Surface color a livid dark brownish slate, with a somewhat bluish cast over the inner surface of the umbrella in preserved specimens. The label accompanying the type contains a note to the effect that the color of the specimen when captured was chocolate brown. Chromatophores small, numerous, and heavily distributed over the entire surface.

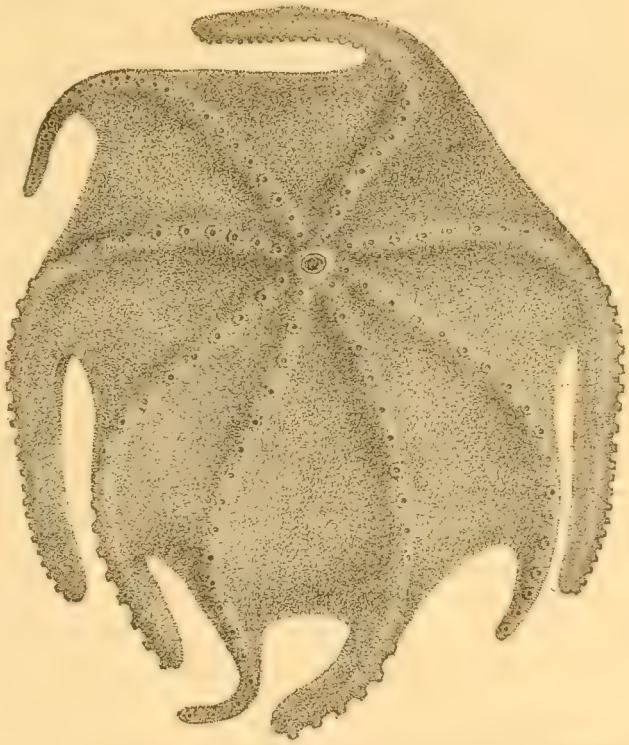

FIG. 1.—*Lætmoteuthis lugubris*, intraumbrellar aspect of type, considerably restored [211], × ⅙. Drawn by R. L. Hudson.

MEASUREMENTS OF LÆTMOTEUTHIS LUGUBRIS.

	Measurement.	Number of suckers.		Measurement.	Number of suckers.
Length of—	*mm.*		Length of—	*mm.*	
Right dorsal arm	430+	18+	Left ventral arm	110+	5+
Left dorsal arm	400+	16+	Umbrella between dorsal arms	300	.....
Right second arm	260+	8+	Umbrella between ventral arms	100	
Left second arm	430+	18+	Funnel	72	
Right third arm	350+	23+	Diameter of one of largest suckers	9	
Left third arm	210+	10+	Length of extracted radula	22	
Right ventral arm	330+	29+	Width of toothed portion of radula	8	

Type.—Catalogue No. 214385, United States National Museum. [S. S. B. No. 211.]

Type locality.—*Albatross* station 3904, surface, off Mokapu Islet, north coast of Molokai, Hawaiian Islands; one fragmentary specimen, April 30, 1902.

Distribution.—Vicinity of Molokai, Hawaiian Islands (*Albatross*).

Specimens examined.—In addition to the type but one other even more fragmentary specimen has been seen. This was taken in the Pailolo Channel near Molokai, from a depth of 258 to 284 fathoms, *Albatross* station 3898 [S. S. B. No. 212].

Remarks.—Both the specimens mentioned are in extremely fragmentary and indeed partially decomposed condition. In the larger example, which has been chosen for the type, only the mouth parts, fortunately together with a large part of the umbrella and the inclosed portions of the arms, remain in a recognizable state. The tips of the arms are missing, and the viscera as well as the eyes have been entirely torn from the body. What remains of the head and mantle is tangled and lacerated beyond repair. The lateral fins still adhere and are fortunately more or less intact. The funnel is present, but there is no trace of the funnel organ. Large fragments of the internal cartilages remain but defy any accurate description at my hands.

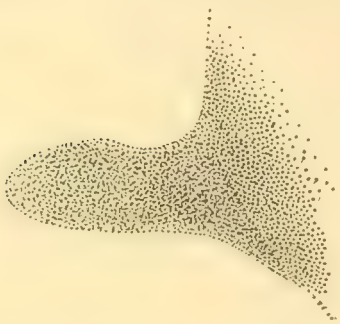

FIG. 2.—*Lætmoteuthis lugubris*, dorsal aspect of left fin of type [211], natural size. Drawn by R. L. Hudson.

The smaller specimen is even more mutilated, so that here only the buccal mass and those portions of the umbrella and arms which immediately adjoin it are left to us.

Even from these wrecks, however, enough has been made out to render it evident that a species is represented which, though closely allied to *Cirroteuthis* and *Stauroteuthis*, differs very markedly in the apparently total absence of cirri on any of the arms as well as the presence of an odontophore, a structure reported to exist in no species of the two genera named except the recently described *C. macrope* Berry from the coast of California. Perhaps, indeed, it is not impossible that the latter species is congeneric.

In addition to the supposed absence of cirri, this species is distinguishable from *Cirroteuthis magna* Hoyle, *C. umbellata* Fischer, *C. megaptera* Verrill, *C. mülleri* Eschricht, and *Stauroteuthis meangensis* Hoyle, by the relatively smaller and differently shaped fins, which are obovate and in outline more nearly like those of *C. pacifica* Hoyle. From the last species, however, the present form differs in the larger, much less numerous suckers,[a] lack of cirri, and less prominent differentiation of the arms from the web. It differs, moreover, from *C. magna*, *C. mülleri*, and *S. syrtensis* Verrill in the lack of an "intermediate web" joining the arms to the umbrella. Correlation of the *Albatross* specimens with the descriptions of *C. caudani* Joubin, *C. plena* Verrill, *C. macrope* Berry, *C. grimaldii* Joubin, or *S. hippocrepium* Hoyle is equally out of the question. The tendency to a zigzag displacement exhibited by many of the suckers might be regarded as a characteristic feature, were it not for the possibility that it is due to distortion. All the basal suckers are relatively very distant from one another, the space between those of the same row being about 25 millimeters, but they gradually become more closely ranked distally.

Of course the possibility must not be overlooked that the apparent absence of cirri may be due to their restriction to the extremities of the arms as above suggested, but to the unfortunate state of preservation of the material. However, the appearance of the specimens in question is such that I have felt obliged to regard the possibility as a remote one, so that the erection of a new group seems expedient.

It is extremely unfortunate that the condition of both specimens is so unsatisfactory, but they belong to a family of abyssal octopods of such elusive habit and tender structure that almost all the described species have been founded upon similar fragmentary material. We have a really complete knowledge of scarcely any of these forms, and it may be that the number of nominal species will have

[a] An appearance which perhaps may be partially due to the loss of the distal portions of the arms, as in quite a number of forms the basal suckers are less crowded than their successors.

to suffer a certain reduction when better methods, better appliances, and more extensive researches have further enriched our museums, but for the present there seems no way of dealing with them except to carefully describe each apparently divergent specimen as it comes in.

The dimensions attained by *L. lugubris* should often be considerable, as when living the larger of the specimens in hand must have had a total arm spread of over 80 centimeters.

Although neither of the Hawaiian specimens was actually obtained from an abyssal depth, there is every reason to believe that such was in reality their place of origin.

Family ARGONAUTIDÆ (Cantraine 1840) Gray 1847.

Argonautides Cantraine 1840, p. 20.
Philonexidæ d'Orbigny 1845, p. 199.
Ocythoina Gray 1847, p. 204.
Ocythoidæ (Argonautidæ?) Gray 1849, p. 3, 28. + *Philonexidæ* Gray, op. cit., p. 3, 29.
Argonautidæ H. and A. Adams 1853, vol. 1, p. 23.
Argonautidæ (pars) Naef 1912b, p. 197, 198.

Octopods of small to moderate size and pelagic habit. Body rounded or slightly elongate; without fins. Sexes conspicuously dimorphic. Males much smaller than the females; hectocotylization affecting one of the ventro-lateral arms, which, having its origin in a specialized sac, becomes developed into a highly modified and detachable copulatory organ, which persists separately for a certain length of time in the mantle cavity of the female. Suckers in two rows on all the arms.

Subfamily ARGONAUTINÆ s. s.

Third right arm of male hectocotylized; outer aspect of hectocotylus smooth. Dorsal arms of female furnished with broadly expanded glandular membranes at their extremities, which serve to secrete and hold in embrace a delicate involute calcareous shell, which latter functions as an ovarium as well as a partial retreat for the animal itself. Articulation between mantle and funnel cartilaginous. Funnel organ comprising a Λ-shaped dorsal cushion and a pair of ventro-lateral pads.

Genus ARGONAUTA Linné 1758.

Argonauta Linné 1758, p. 708.
Nautilus Schneider 1784, p. 120 (not of Linné 1758).
Ocythoe Leach 1817, p. 295 (not of Rafinesque 1814).
Hectocotylus (pars) Cuvier 1829, p. 147.
Todarus Rafinesque 1840, p. 64 (*fide* Binney and Tryon, p. 94).
Argonauta d'Orbigny 1845, p. 210.

For the characters of this genus see above under the subfamily, of which this is the only known group. Here are included the familiar argonauts or "paper nautili." At least two species are inhabitants of the Hawaiian region.

Type.—Argonauta Argo Linné 1758 (the species first mentioned), a characteristic Mediterranean type.

Argonauta böttgeri Maltzan 1881. (Pl. XLVIII, fig. 5.)

Argonauta Böttgeri Maltzan 1881, p. 163, pl. 9, fig. 7.
Argonauta böttgeri Smith 1887, p. 409, pl. 17, fig. 1–6.
Argonauta Böttgeri Hidalgo 1905, p. 9 (*fide* Hoyle 1909).
Argonauta bœttgeri Dall 1908, p. 226, 229.
Argonauta böttgeri Berry 1909, p. 418 (locality record only).

Animal small, pelagic. Male (with the exception noted below) unknown. Body of female smooth, elongate, in general cylindrical, twice as long as broad; posterior part of body with a sharp upward torsion, at least in animals preserved in situ within the shell; rounded below, elevated and bluntly pointed posteriorly, widest in front, much elevated just back of the nuchal region. Mantle margin thin; pallial opening very wide, reaching well above the eyes on either side.

Head small and very indistinctly delimited because so deeply embraced in the mantle. Eyes large, spherical, protruding, a distinct constriction separating them from the head at the base. Funnel of robust proportions, but thin-walled and extremely long, reaching nearly midway of the ventral arms; broad at the base, but thence rapidly tapering to the simple circular aperture at the apex. Funnel organ prominent, of a whitish color; it comprises a large Λ-shaped cushion on the dorsal wall a little anterior of the middle, and a somewhat shorter and narrower elongate-ovate organ on either side of the ventral wall just below it (fig. 5). Locking apparatus well developed; just behind and a little below the eye, the basal margin of the funnel on either side is furnished with a small cartilaginous pit-like depression, which articulates with a posteriorly directed, roughly hook-like nodule on the inner surface of the mantle; just outside this nodule and passing below it parallel to the mantle margin, a shallow, though distinct, groove coincides with a similar sulcus on the outer surface of the mantle, so that the constriction thus formed renders very prominent the thickened band of transverse muscle bordering the mantle opening.

FIG. 3.—*Argonauta böttgeri*, lateral view of female [165], × 2. Drawn by R. L. Hudson. The drawing does not show the characteristic flexures of the body.

Arms of moderate length, perhaps half again as long as body, sharply separated from body at base by a deep sulcus; order of length 1, 2, 3, 4; dorsal arms somewhat the thickest and strongest as well as the longest, their distal portions furnished with the usual conspicuous wing-like expansions of the marginal membrane, much wrinkled and contracted in preserved specimens so that its exact outline is very difficult of determination; remaining arms broad at the base, but rapidly tapering to an attenuate extremity. Umbrella rudimentary, comprising only a short fold interwebbing all the arms for a distance of about three millimeters from their base. Suckers very large, much elevated, 40 to 50 or more in number on each arm (on the dorsal arms over 50 suckers in each row, on the second and third arms about 30 in each row, and on the ventral arms about 18 to 20 in each row); compactly and very regularly ranked in two alternating rows, which on the second arm (and to a very slight degree on the others as well) become ultra-marginal and very widely separated distally (pl. XLVIII, fig. 5); cups flattened and discoid; both rows persistent to the tips of all the arms, though vastly reduced on the

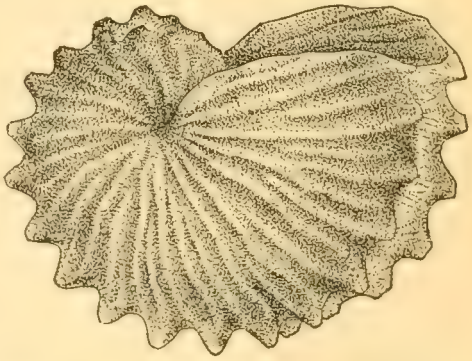

FIG. 4.—*Argonauta böttgeri*, lateral view of shell of female [165], × 2. Drawn by R. L. Hudson.

modified extremities of the dorsal pair, on which latter only the basal 15 to 16 are at all well developed. The funnel is connected to the head dorso-laterally by a pair of delicate bridle-like connective membranes, which are continuous with a delicate keel running along the lower aspect of each ventral arm; otherwise the arms are rounded and devoid of keels or swimming membranes. Dorso-laterally the integument of the head is connected with the dorsal arms by a delicate vertical membrane bridging the sulcus which otherwise separates the arms and head, and two similar but smaller membranes bridge the constriction between the anterior boundary of the eyeball and the lateral arms.

FIG. 5.—*Argonauta böttgeri*, outline drawing of funnel laid open medioventrally to show the funnel organ [165], × 2.

Shell small for the genus, coiled very compactly in an even plane, laterally compressed; the sides ornamented with some 30 or more conspicuous ridges radiating from the shallow depression which is the outward mark of the shell axis; periphery flattened, each angle decorated with a row of bluntly squared tubercles, 17 to 18 of which can be made out on each side; margin of aperture simple, without any trace of lateral expansions or "auricles;" surface finely and quite evenly granulose, the granules most numerous on either side of the shell near the axis and visible without the aid of a lens (fig. 4).

General surface color of animal in alcohol everywhere a pale brownish buff, dotted more or less impartially with numerous fairly large bluish black chromatophores, which are nowhere crowded save on the outer aspect of the dorsal arms and in less degree the dorsal integument of the eyeball. Beak coal black.

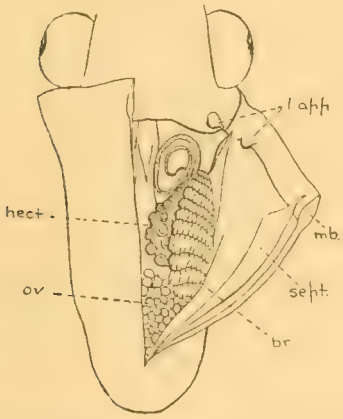

FIG. 6.—*Argonauta böttgeri* [165], ventral aspect of female, with mantle laid partially open to show the detached hectocotylus of the male in situ within the pallial chamber, × 2: br., gill; hect., hectocotylus of male; l. app., locking cartilages of left side; mb., thickened band of muscular tissue bordering mantle margin; ov., gonad; sept., median septum of pallial chamber.

As no male animal of this species has come to hand the above description applies only to the female. However, the mantle of the specimen before me was carefully laid open along the medioventral line; lying within the cavity, its thickened basal portion lodged snugly just above the left gill between the latter organ and the viscera, was found the detached hectocotylus of a male. This condition is well shown in the accompanying sketch, which indicates the position of the structures in question in situ (text fig. 6); see also the more detailed representation of the hectocotylus in figure 7. The organ comprises a thickened basal portion curved in the shape of a horseshoe about 6 mm. in length by a little more than 4 in breadth, with the inner or sucker bearing aspect outermost; widest between the middle and the base, tapering slightly to a rounded point posteriorly, and more gradually to the acute distal extremity which terminates in a very long and slender thread-like process, lying in a loose coil; the basal portion broadly flattened on its inner surface, the margin of the latter armed with a closely placed row of minute much elevated suckers, about 22 on each border, which are connected by a delicate hyaline membrane; the outer aspect (i. e., inner curve of the horseshoe) is keeled and bears a conspicuous marginal membrane, which even continues along the terminal thread, though there becoming extremely thin and delicate. The diameter of the basal portion is 2 mm.; the length of the flagellum about 13 mm.

The shell of this specimen was partly full of eggs and young embryos connected into a loose mass by fine filaments and representing various early stages of development. The total number is several hundred at least, the largest scarcely a millimeter in length.

MEASUREMENTS OF ARGONAUTA BÖTTGERI.

	mm.
Total length (to tip of second arms)	59
End of body to base of dorsal arms	23
End of body to ventral margin of mantle	21
Width of body near middle	10
Width of mantle anteriorly	13
Width across eyes	13
Length of—	
Right dorsal arm to expanded portion (inside measurement)	15
Left dorsal arm to expanded portion (inside measurement)	17
Length of—	
Right second arm (inside measurement)	36
Left second arm (inside measurement)	35
Right third arm (inside measurement)	28
Left third arm (inside measurement)	31
Right ventral arm (inside measurement)	15+
Left ventral arm (inside measurement)	22
Funnel	15
Diameter of largest suckers	2
Diameter of shell	31

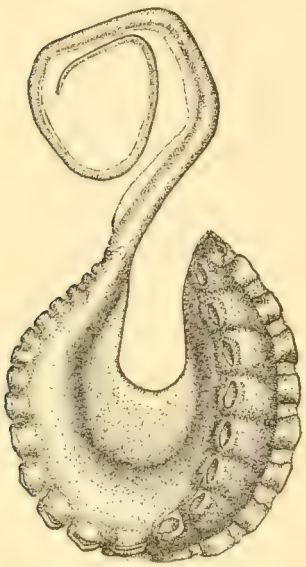

FIG. 7.—*Argonauta böttgeri*, hectocotylus of male [165], × 8.

Type.—?

Type locality.—Unknown.

Distribution.—Mauritius (Smith); Chagos Islands (Smith); Masbate, Philippines (Smith, Hidalgo); China Sea (Smith); Australia (Smith); Hawaiian Islands (*Albatross*).

Specimens examined.—A single adult female containing a hectocotylus and numerous embryos was taken by the *Albatross* in the surface net at station 3927, latitude, 21° 31′ N., longitude, 161° 55′ W., between Honolulu and Laysan Island. The specimen constitutes catalogue No. 214377 United States National Museum [S. S. B. 165].

Remarks.—*Argonauta böttgeri* is not only one of the smallest species of the genus, but one of the most delicately beautiful as well. Its discovery in Hawaiian waters extends its known distribution many thousand miles to the northeast, and further enables me to publish the first detailed description of the animal. When compared with the Mediterranean *A. argo* (see Jatta 1896, p. 191, pl. 8, fig. 3, pl. 18, fig. 15–29), which is the only other form of which I have seen a complete account, important differences are found to be numerous. Most obvious are perhaps the following: In *A. argo* the ventral arms are longest, the third pair shortest; the body is shorter and more inflated; also the suckers are larger and more crowded, and the eyes are larger. Details in the shape and proportions of the funnel organ (narrower in *A. argo*), hectocotylus (also narrower in *A. argo*), and other structures are also noteworthy. The shell of the present species seems unique in its small size, compact coil, and the circumstance that the auricular expansion at the sides of the aperture, so frequently developed in other species of the genus, are here notable only for their entire absence.

With the exception of the detached hectocotylus as above described, the male of this species was not encountered by the *Albatross*, so unfortunately is still unknown.

Argonauta species.

Argonauta (*argo* Linnæus ?) Berry 1909, p. 418 (locality record only).

From a depth of 127–128 fathoms in the Pailolo Channel, *Albatross* station 3857, were obtained a few badly shattered fragments of a shell which is clearly not referable to *A. böttgeri* [S. S. B. 216]. The nearly complete columella shows the shell to have been auriculate in form, which would indicate that the species represented is probably of the group of *A. argo* and possibly close to *A. pacifica* Dall. The surface of the fragments shows a fine, almost obsolete granulation.

Subfamily TREMOCTOPODINÆ.

Philonexidæ H. and A. Adams 1858, vol. 1, p. 21.
Tremoctopidæ Tryon 1879, p. 130.
Tremoctopodidæ P. Fischer 1882, p. 334.
Tremoctopodinæ Berry 1912b, p. 386.

Adult small. Third left arm of the male hectocotylized; its outer surface ornamented with fringe-like papillæ. Dorsal arms of female connected at base by a broad veliform membrane, which extends along their margins, leaving only the very attenuate and frequently decollated extremities free. Remaining arms webbed only at the base, their suckers larger and better developed than those of the dorsal pair. No calcareous egg case or shell. Two large aquiferous pores on the dorsal aspect of the head and a smaller one at either side ventrally just in front of the funnel. Mantle articulating with the funnel by membranous folds; no definite locking cartilages. Funnel organ poorly developed and represented only by a series of longitudinal lamellæ.

Genus TREMOCTOPUS Delle Chiaje 1829.

Tremoctopus Delle Chiaje 1829, T. 70, 71 (*fide* Wülker).
Octopus (*Philonexis*) d'Orbigny 1835, p. 14.
Philonexis d'Orbigny 1845, p. 200.
Tremoctopus Naef 1912b, p. 199.

Since only the single genus of the group is known, its characters are entirely those of the subfamily.

Type.—Tremoctopus violaceus Delle Chiaje 1829 (monotypic), a species originally described from the Mediterranean.

Tremoctopus violaceus Delle Chiaje 1829. (Pl. XLIX, fig. 3, 4.)

? *Tremoctopus violaceus* Delle Chiaje 1829, T. 70, 71 (*fide* Wülker).
Octopus gracilis Souleyet in Eydoux and Souleyet 1852, p. 13, pl. 1, figs. 8–9.
? *Octopus dubius* Souleyet in Eydoux and Souleyet 1852, p. 15, pl. 1, figs. 10–14.
? *Tremoctopus dubius* Tryon 1879, p. 131, pl. 43, fig. 80, 81 (after Souleyet).
Tremoctopus gracilis Tryon 1879, p. 131, pl. 43, fig. 82, 83 (after Souleyet).
Tremoctopus quoyanus Hoyle 1904, p. 12, fig. A.
Tremoctopus sp. (near *quoyanus* d'Orbigny) Berry 1909, p. 418 (locality record only).

Animal small, pelagic. The sexes are so conspicuously dimorphic that a separate description is necessary.

Female: Mantle short; width about equal to length; pouch-shaped, widest anteriorly, and either simply rounded behind or rapidly narrowing to a rounded point; a sharp median longitudinal groove on the ventral surface indicates the position of the median septum of the mantle cavity. Mantle opening very wide and full, extending to a point just above the center of the eye on either side, but well behind it; mantle of scanty extent below, so that its margin barely meets the posterior edge of the funnel.

Head large, flattened; extremely short and broad, the large prominent rounded eyes rendering it usually wider than the body. Eyes not at all pedunculated. Entire surface covered by a loose smooth delicate skin or cuticle of hyaline consistency and unpigmented, which is perforated by four small oval openings—the so-called aquiferous pores—a pair on the dorsal aspect being situated one at the base of each dorsal arm just a little outside the axis of the latter, and another pair about half as large situated one at the base of each ventral arm at either side of the tip of the funnel. Funnel large, compressed, very broad at the base, its outline almost that of an equilateral triangle; only the narrow apex free. Funnel organ composed of a number of longitudinal lamellæ or folds, terminated near the apex by a small acutely pointed valve-like flap. (Pl. XLIX, fig. 4.) The base of the funnel just over the retractor muscles articulates with pocket-like grooves on the inner surface of the mantle by means of a thickened and recurved fold of the posterior margin.

Arms (pl. XLIX, fig. 3) slender, graceful; decidedly unequal, order of length 1, 2, 4, 3; dorsal arms decidedly longest and when perfect terminating distally in a very long delicate thread-like process; second arm pair a little shorter than the first, notably stouter, wider and less attenuate; third arms decidedly

the shortest, usually a very little longer than the mantle in adult specimens and about a third as long a, the dorsal pair; all the arms smooth externally, without keels or carinations. Umbrella thin, delicates hyaline; but little developed between the ventral arms, between these and the third pair, and between the latter and the second pair; very extensive between the four dorsal arms, where it attains its maximum, connecting the first and second arm on each side for nearly half their length, but somewhat more deeply cleft between the dorsal arms; continuous along the dorsal margin of the second pair as a delicate web constantly narrowing distad, but along both borders of the dorsal arms it maintains itself as a promi-

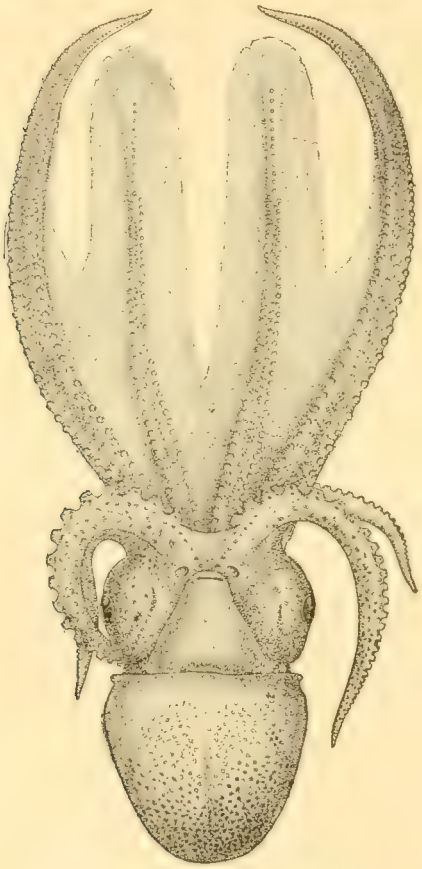

FIG. 8.—*Tremoctopus violaceus*, ventral view of large female [221], from station 3930, × 2. Drawn by R. L. Hudson.

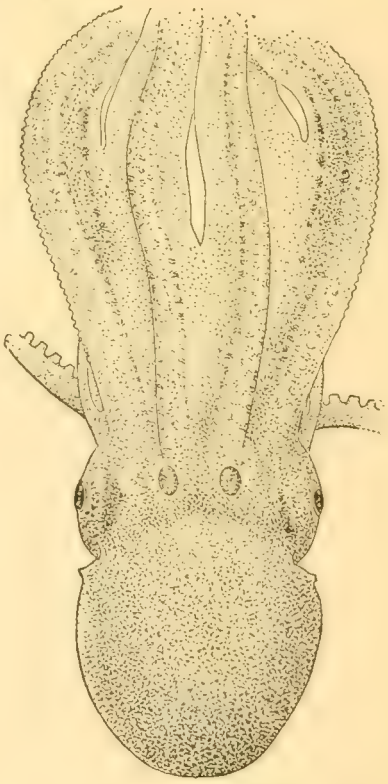

FIG. 9.—*Tremoctopus violaceus*, dorsal view of specimen [221], shown in figure 8, × 2. Drawn by R. L. Hudson.

nent veliform web, ofttimes even broader than the arms themselves, only the filiform extremities of the arms remaining free. In most adult specimens these tips and even the more distal portions of the webbed regions are abruptly decollated.

Suckers small, regularly alternating in two very widely spaced rows, save the basal three which are in a single row and notably larger than any of the remainder except those on the ventral arms which are greatly elevated, cylindrical in shape, much fewer in number, and the rows less widely interspaced. Except at the base the suckers of the four dorsal arms are numerous, much reduced in size, little elevated, and with very small openings; they soon become entirely rudimentary and suddenly crowded laterally

into practically a single row on the distal portion of the dorsal arms, contemporaneous with the general atrophy of the arm itself. The suckers of these arms are ultramarginal except as just noted, and the rows very widely spaced; the suckers of the third arms are somewhat intermediate between this condition and that which prevails on the ventral pair.

Male: Body much smaller, perhaps half as large as that of the female, but quite as variable in shape (figure 10 shows the extreme of rotundity). Arms relatively shorter and more delicate than in the female; the four dorsal arms much less highly specialized, their tips normal, and the very delicate webbing not so well developed. Right ventro-lateral arm hectocotylized, the modification affecting the entire arm, which attains its development in a specialized sac occupying the region which would ordinarily be the base of the arm between the base of the funnel and the eye. (Cf. the account given by Steenstrup, 1857, p. 103–105.) It is visible through the thin overlying integument even in very young specimens as a whitish vermiform body compactly coiled upon itself in such a fashion as to occupy as little space as possible. This arm undergoes a much more rapid growth than the rest of the animal, so that in males measuring about 3 cm. in length (station 4010) the sac is already vigorously crowding the eye and funnel and the animal has consequently a somewhat lopsided appearance; at this stage also the sac has begun to bulge forth by the side of the mouth as a large rounded tumor-like protuberance. In the large mature male from station 4086, the arm had apparently just broken from its sac, but still remained attached by its basal end at the time of capture. At this stage the hectocotylized arm is a highly complex structure as long or longer than the animal itself. It differs very markedly from the hectocotylus of *Argonauta* and may be briefly described as follows:

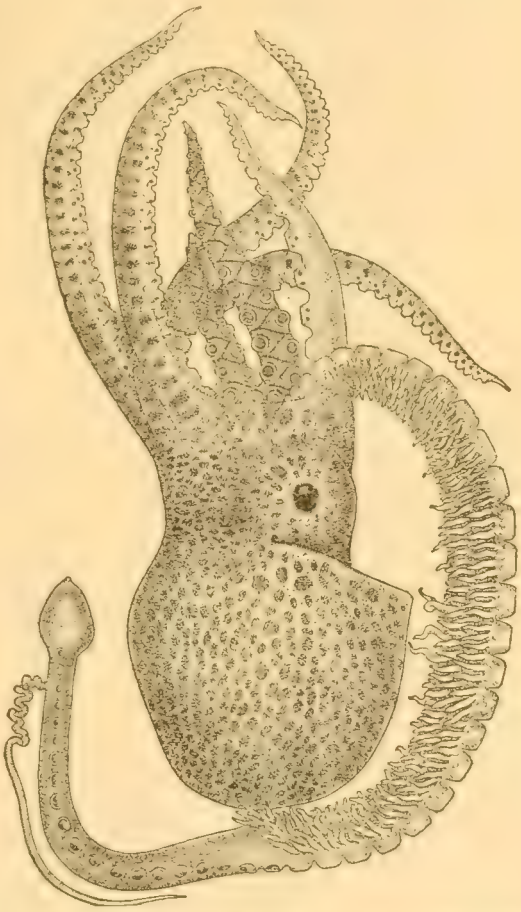

FIG 10.—*Tremoctopus violaceus*, lateral view of adult male, from station 4086, with nearly ripe hectocotylus [225]. × 4 Drawn by R. L. Hudson.

Much flattened; widest about a third of the way above the constricted and bluntly pointed base. Inner surface bearing about 46 pairs of closely placed suckers ranked in two rather widely interspaced marginal rows; outer surface ornamented with a conspicuous double fringe of long acutely conical papillæ, which extend laterally just above the suckers along the proximal two-thirds of the arm; when the distal third of the arm is reached, the papillæ suddenly cease, the outer surface becoming much flattened, naked, and perfectly smooth. Between the rows of papillæ the skin is minutely ridged and tubercled; near the base an irregular series of small rounded tubercles along the median line gives way on the smooth part to a very fine longitudinal costation; on either side a flanking series of low rounded transverse ridges persists along the entire papillate portion of the arm. The apparent differentiation of the arm into regions extends even to the suckers, the 27 pairs arming the papillate portion of the arm being very different from the remainder. Here the suckers are crowded, thickened, massive, elevated,

with swollen bases; at first small, they reach their maximum at about the twelfth to fourteenth pairs, whence they again suffer a gradual diminution in size. The apertures of the first 17 pairs are slitlike and so laterally compressed that the openings are scarcely evident; the next 10 pairs smaller and with more open apertures, the aperture of the twenty-seventh where the papillæ cease being wide open. The following 19 pairs are very differently modified: at this point the interspace between the rows widens, the suckers becoming ultramarginal and facing much more laterally; they are smaller, lower, regularly and gradually diminish in size, and have wide, simple, outwardly flaring apertures. The tip of the arm is occupied by a small bulbous expansion devoid of any armature save a slender pointed filiform process extending distally from its pointed tip. Just proximal to the bulb and about three pairs of suckers from the end, the inner surface of the arm gives rise at its middle to a very long delicate colorless thread, which is so coiled upon itself that it can not be entirely straightened out without danger of breaking. This thread appears to be incased in a tenuous hyaline skin, is thickest beyond the coiled portion, and thence tapers to an attenuate and pointed extremity (fig. 10).

Several of the females were examined to ascertain the possible presence of a free hectocotylus within the mantle cavity, but without success.

The dimensions of the hectocotylus above described are as follows:

	mm.
Total length, exclusive of thread	44
Length of papillated portion	28
Length of terminal bulb and process	4
Length of thread	15+
Maximum diameter	3

Young: The series at hand is replete with immature specimens comprising all the later stages of development, the smallest having a mantle length of about 6 mm. Great variation is evident, especially in the shape and general proportions of the arms and body, but all maintain with great constancy the arm formula 1, 2, 4, 3. The third arms in the smallest specimen (station 3799) are so little developed as to be hardly distinguishable. All the arms are relatively much shorter than in the adult, the suckers fewer and larger in comparison, the umbrella very rudimentary and about equally developed all round, and the eyes rendered more conspicuous through their dark coloration. A slightly later stage (station 3878) shows the arms to have grown rapidly and to be already longer than the body. In males of this size the hectocotylized arm is already well advanced, but in the female the extraordinary development of the umbrella and attenuation of the dorsal arms does not become apparent until the animal has attained a much larger size.

Color of specimens preserved in alcohol everywhere a very pale brownish buff, the eyes with a silvery metallic sheen beneath the integument. Chromatophores fairly numerous, especially just above and behind the eyes, but usually more or less indistinct except in the younger specimens where they are fewer in number and much more conspicuous. A single row of three to five large rectangular chromatophores commences along the base of each dorsal arm, but is soon superseded by a double series of much smaller roundish ones. There is also a pair of rather large chromatophores placed transversely between the eyes, a pair of similar but more widely separated ones behind them, and a single small one near the center of the group. Young specimens show in addition a single line of small dark chromatophores bordering the ventral mantle margin, and sometimes an aggregation of similar chromatophores forms a conspicuous spot on each side of the body just behind the eyes (e. g., the individuals from station 3799, where both males and females appear almost different enough in this and other particulars to constitute a different species; the single individual from station 3929 is the only other specimen seen which shares the foregoing peculiarity).

Type locality.—Of *violaceus*, the Bay of Naples, Italy; of *gracilis*, long. 106° W., lat. 8° N., Pacific Ocean (*fide* Tryon).

Distribution.—Of *violaceus*, Mediterranean (Delle Chiaje, Jatta, etc.); middle Atlantic; Japan (Wülker). Of *gracilis*, eastern mid-Pacific (Souleyet); neighborhood of the Hawaiian and Midway Islands (*Albatross*); eastern tropical Pacific (Hoyle, as *quoyanus*); between Papua and Japan (Hoyle); near Mauritius (Souleyet, as *dubius*).

MEASUREMENTS OF TREMOCTOPUS VIOLACEUS.

Number in author's register	221	221	218	219	218	218	217	223	225	218	224	217	218
Station where taken	3930	3930	3878	3926	3878	3878	3799	4010	4086	3878	4011	3799	3878
	♀	♀	♀	♀	♀	♀	♀	♂	♂	♂	♂	♂	♂
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Total length	64+	51+	48	44+	33	30	6	30	24+	25	21	15	14
Length of mantle (dorsal)	16	13	10	10	9	8	3	10	8	7.5	6	6	4.5
Width of mantle	15	11	10	10	9	7	3	7	10	7	6.5	7	4.5
Width of neck	13	10	8	8	8	6	.....	7	8	5	.....	.....	4
Width of head	15.5	12	11	11	10	8	2.5	8	9	7.5	7	6	4.5
Length of funnel	7	7	5	.....	4.5	3	.....	4	5	3.5	.....	2	2
Length of right dorsal arm	40+	37+	34	28+	22	18	2.5	18	10+	16	14	9	9
Length of left dorsal arm	40+	27+	31	31+	22	20	2.5	.....	10+	16	.....	9	9
Length of right second arm	33+	37	28	27	20	16	1.5	16	.....	14	12	8	6.5
Length of left second arm	45	34+	17+	.....	20	18	1.5	.....	14+	14	.....	8	6.5
Length of right third arm	20	15	11	11	10	7	.....	.....	42	.....	.....	.....	.....
Length of left third arm	20	15	11	.....	10	.....	.....	8	7	4.5	4	3	1.5
Length of right ventral arm	32	25	16	19	14	12	1	.....	14	9	6	2	3.5
Length of left ventral arm	32	25	16	.....	14	.....	1	12	.....	9	6	2	3.5
Length of umbrella between dorsal arms	14	13	9	9	7	3	.....	6	6	3.5	4.5	2	.5
Length of umbrella between ventral arms	3	3	2	2	1	1	.....	1	3	1	1	.....	.....
Length of umbrella between dorsal and second arms	22	17	11	11	9	4	.....	6	5	3.5	4	.....	.....

Material examined.—The 31 specimens examined are of various ages but almost equally males and females:

No. specimens.	Locality.	Depth.	Albatross station No.	Sex.	Author's register No.
4	Lat. N. 29° 22′, long. W. 139° 31′, between Erben Bank and Kaiwi Channel	Surface	3799	1♂3♀	217
5	Off Molokini Islet, Kahoolawe	...do	3878	2♂3♀	218
3	Lat. N. 21° 13′, long. W. 158° 43′, between Honolulu and Laysan Island	...do	3926	♀	219
1	Lat. N. 23° 19′, long. W. 166° 54′, between Honolulu and Laysan Island	...do	3929	♂	220
3	Lat. N. 25° 07′, long. W. 170° 50′, between Honolulu and Laysan Island	...do	3930	1♂2♀	221
2	Lat. N. 25° 27′, long. W. 171° 08′, between Honolulu and Laysan Island	...do	3931	♂	222
4	Between Kauai and Oahu	...do	4010	3♂1♀	223
7	.....do	...do	4011	3♂4♀	224
2	Off Puniawa Point, Maui	...do	4086	♂	225

Remarks.—Owing to the great confusion which prevails in the various published accounts of the species of this genus, the identification of even so excellent a series of specimens as the present is not an easy task and the final conclusion attained is not altogether satisfying. It must be admitted that the temptation is very great to unite practically all the alleged species of *Tremoctopus* under the oldest name of which we chance to have knowledge as applied to a member of this group—the *Tremoctopus violaceus* Delle Chiaje 1829. This is in effect what has been done by Jatta [a] (1896, p. 204) and more

[a] Jatta includes all the following in the synonymy of *T. violaceus:*
Octopus velifer Férussac 1830.
Philonexis Quoyanus d'Orbigny 1835.
Philonexis atlanticus d'Orbigny 1835.
Philonexis microstomus d'Orbigny 1835.
Philonexis hyalinus d'Orbigny 1835.
Octopus (*Philonexis*) *brevipes* d'Orbigny 1835.
Octopus semipalmatus Owen 1836.
Octopus velatus Rang 1837.
Octopus Kollikeri Vérany 1847.

recently by Naef (1912*b*, p. 199). Wülker has likewise reported under the same name a species of the genus from Japan (1910, p. 5). Not having any material from other regions available for comparison, I have felt constrained to follow the precedent thus made for me, especially since I have not been able to seize upon any characters of sufficient definiteness to separate the Pacific species from the Atlantic. Nevertheless it should be remembered that our knowledge of the group is still woefully incomplete, and a careful account is needed of all the diverse stages which specimens from the various regions pass through during their life history, before absolute confidence can be felt in such wholesale relegation to the synonymy.

Should it eventually appear that there are more species of *Tremoctopus* than recent writers are inclined to admit, I have no doubt whatever that the Hawaiian specimens are identical with the form described by Souleyet as *Octopus gracilis*. Tryon (1879, p. 131) gives the following brief paraphrase of his very inadequate description: "Body rounded, smooth; head small; eyes large, prominent; arms graceful, the upper very long, lower short, connected by a web. Phosphorescent and with metallic reflections when living. Length 24 mm."

Certainly these few lines contain little which can serve either to prove or to disprove the identity of Souleyet's specimen with those obtained by the *Albatross*, but upon turning to the figure we find a representation which accords very well with Hawaiian specimens of the same size, and as both are from the same general oceanic region and the habit of the animals is admittedly pelagic, we find at once a strong *a priori* reason for uniting them. From the present specimens the figure of *O. gracilis* differs most strikingly in its more inflated body (a character of trifling importance) and somewhat wider web between the ventral arms. The eyes are also represented as being semipedunculate, but I suspect that this appearance may be due to the loss of the delicate integument which usually envelops the head. The proportions of the arms are, however, much the same, and it is further noteworthy that a specimen presumably of this species taken by the *Challenger* in the western Pacific differs in no described character from the *Albatross* specimens (Hoyle 1886, p. 71).

With the same form I would be also disposed to unite the *Octopus dubius*, also of Souleyet, especially since the most immature of the specimens before me is almost a counterpart of his figure and is of similar dimensions (6 mm.).

The two female specimens dredged by the *Albatross* in the tropical Pacific, which Hoyle (1904, p. 12) referred with some doubt to *T. quoyanus*, likewise agree perfectly in all the characters stated, have the same curious arrangement of the chromatophores, and are surely conspecific. The single poorly preserved individual taken by the *Challenger* in the south Pacific (Hoyle 1886, p. 70) also is probably identical, so that on the whole it can be affirmed with certainty that few Hawaiian cephalopods exhibit a wider distribution.

The species is one of the most beautiful and graceful of all cephalopods.

Family ALLOPOSIDÆ Verrill 1881.

Alloposidæ Verrill 1881, p. 365.
Argonautidæ (pars) Naef 1912b, p. 197, 198.

Sexes dimorphic, the female larger than the male and often attaining considerable dimensions. Body soft and gelatinous, aquiferous pores lacking. Arms united throughout the greater portion of their length by an extensive umbrella; suckers in 1–2 rows. Hectocotylization affects the whole of the right third arm, which has its origin in a specialized sac in front of the eye, and when mature is most probably caducous.

Genus ALLOPOSUS Verrill 1880.

Haliphron Steenstrup 1859, p. 183 (nomen nudum, *fide* Hoyle).
Alloposus Verrill 1880, p. 393.
Alloposus Verrill 1881, p. 365.
Alloposus Hoyle 1886, p. 72.
Alloposus Naef 1912b, p. 198.

This being the only known genus, its characters are entirely those of the family.

Type.—Alloposus mollis Verrill 1880 (monotypic), originally described from off the New England coast.

Alloposus mollis Verrill 1880.

? *Haliphron atlanticus* Steenstrup 1859, p. 183 (*fide* Hoyle).
Alloposus mollis Verrill 1880, p. 394.
Alloposus mollis Verrill 1881, p. 366, 420, 434, pl. 50, 51, figs. 3–4.
Alloposus mollis Hoyle 1886, p. 7, 72.
Alloposus mollis Joubin 1895, p. 4, 13, 55, pl. 5, fig. 1, 3, 10, 11, pl. 6.
Alloposus mollis Joubin 1900, p. 11, 30, 127, pl. 5, fig. 14, 15; pl. 11, fig. 1.
Alloposus mollis Berry 1909, p. 418 (locality record only).

Body large, soft, smooth, semigelatinous in consistency, in shape ovoid, widest in front, narrower and rounded posteriorly.

Head short and very broad; when contracted the lids of the large prominent eyes appear to have distinct openings. Mantle opening very wide and full, extending in two broad pouchlike curves from the median point of union with the ventral commissure to a point just past the eye on either side. Medio-ventral septum or commissure well developed, extending nearly to the anterior margin of the mantle, and thence reaching its dorsal attachment through a sinus in the posterior margin of the funnel. Funnel enormous and almost entirely exposed; its apex reaching slightly past the eyes; fused with the ventral integument of the head for almost its entire length. Funnel organ extremely anterior in position and very large, comprising a broad W-shaped pad of a conspicuous brown ochre color; posterior lobes rounded; anterior lobes acute and almost meeting in the median line below (fig. 12).

Arms moderate, decreasing in length and degree of attenuation from the dorsal to the ventral pair (in the present specimen their extremities are badly mutilated); connected at the base by a broad membranous umbrella, the latter attaining its greatest extent between the arms of the dorsal pair which it interwebs for much the greater portion of their length. Suckers large, elevated, deep, their rims of somewhat more massive consistency than the other tissues of the animal; they are in two rows, or rather in a single more or less zigzag row which most conspicuously approaches the two-rowed condition after reaching the margin of the umbrella (at about the thirteenth sucker on the dorsal arms).

The entire integument is of a somewhat stringy semigelatinous consistency. It does not preserve well and is badly torn away from the right side of the present specimen.

Color of specimen preserved in formalin and alcohol a muddy buff, numerous brownish chromatophores are distributed over the dorsal surface and to a considerably less extent below.

MEASUREMENTS OF ALLOPOSUS MOLLIS.

	mm.		*mm.*
Total length	147+	Length of—	
Tip of body to base of umbrella between dorsal arms	65	Left second arm	7[illegible]+
Length of body	50	Right third arm	65
Width of body	46	Left third arm	51+
Width across eyes	51	Right ventral arm	6[illegible]+
Length of—		Left ventral arm	[illegible]+
Right dorsal arm	82+	Umbrella between dorsal arms	54
Left dorsal arm	60+	Umbrella between ventral arms	44
Right second arm	90	Funnel	38
		Diameter of one of largest suckers	4

Type.—In the United States National Museum. A cotype (from *Fish Hawk* station 893) is in the Yale University Museum.

Type locality.—*Fish Hawk* station 880, 252 fathoms, off Newport, Rhode Island, September 13, 1880; three specimens.

Distribution.—Off Newport, Rhode Island (Verrill), off Chesapeake Bay (Verrill); north Atlantic (Hoyle, Joubin); off Marthas Vineyard, Massachusetts (Verrill); off Delaware Bay (Verrill), off the Azores (Joubin).

Pailolo Channel, Hawaiian Islands (*Albatross*).

Verrill gives the bathymetric range of the species as 236 to 1,346 fathoms. Fragments of this species have been obtained from a depth of 1,735 fathoms and likewise from the surface.

Material examined.—One immature female was taken by the *Albatross* in 286 to 290 fathoms, station 4095, northeast approach to Pailolo Channel [S. S. B. 209]. It is catalogue No. 214378 of the United States National Museum.

Remarks.—This interesting species has been described in such excellent detail by Verrill, Joubin, and other writers, that I have endeavored in the above paragraphs to give merely an account of the more salient characters of the species as they appear in the specimen at hand, and to add an account of the funnel organ which has hitherto remained undescribed. The latter is chiefly interesting for its relatively anterior position and great size, for in general outline it does not specially differ from the usual W-shaped type of organ prevalent in most octopod genera.

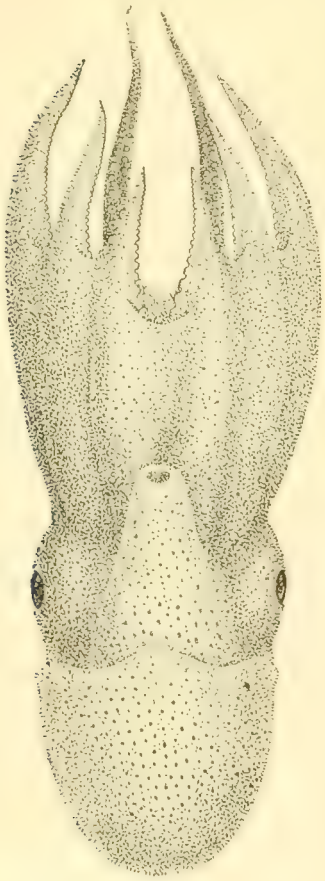

FIG. 11.—*Alloposus mollis*, ventral view of small female, from the Pailolo Channel [209], × 2/3. Drawn by R. L. Hudson.

As this species has not hitherto been reported from the Pacific, there would seem to be strong reasons for doubting its identity with the Atlantic *A. mollis*, if on no other than geographical grounds, yet I have been unable to find any characters which could be used in separately defining it. Perhaps this is due to the obvious immaturity of the present specimen, for an individual observed by Verrill (1881, p. 420) was nearly 79 cm. in length and weighed over 20 pounds, while a single dorsal arm recorded by Joubin (1900, p. 32) is 161 cm. long.

FIG. 12.—*Alloposus mollis* [209], outline drawing of funnel laid open medioventrally to expose funnel organ, natural size.

An allied form—*A. pacificus* Ijima (see Ijima and Ikeda 1902, p. 87, footnote)—has been described from the Sagami Sea, Japan. The chief character advanced by the author to separate this form from *A. mollis* is simply that the suckers "are arranged in a single row for the greater part of the arm length, being biserially arranged only in the free tip." That, unless supported by other structural differences, this feature is of no very weighty importance is readily seen upon examination of the present specimen, for whereas one author might describe the arrangement of the acetabula as unmistakably in two rows, another might as positively assert them to be uniserial. The truth is that, as Hoyle has shown in the case of Polypus (1886, p. 76; 1904, p. 18–19), all the suckers are morphologically to be regarded as ranked in a single row, the component members of which have undergone a greater or less lateral displacement to each side in alternation, the resulting biserial appearance being purely secondary. In this respect *Alloposus* occupies an intermediate position and hence the claims of *A. pacificus* to recognition as a good species can not yet be taken as established, even though in the absence of a complete description of the Japanese form it would be premature to unite the two dogmatically.

Family BOLITÆNIDÆ Chun 1911.

Bolitænidæ Chun 1911, p. 20.

Body semigelatinous. Third arms much the longest and largest; suckers on all the arms in a single row. Right third arm hectocotylized, the chief modification consisting in the enlargement of a part or even all of the suckers. Olfactory organ papilliform.

Genus ELEDONELLA Verrill 1884.

Eledonella Verrill 1884, p. 144.
Eledonella Chun 1911, p. 16.

Body gelatinous, weakly pigmented, semitransparent. Hectocotylization affecting only the distal suckers of the arm.

Type.—Eledonella pygmaea Verrill 1884 (monotypic), a species of the New England region.

Eledonella species (young).

Bolitæna species Berry 1909, p. 418 (locality record only).

Mantle saccular, much wrinkled, longer than broad. Arms short, incompletely webbed; the 4 to 6 large suckers arranged in a single series. Funnel small, little projecting. Head small. The single specimen obtained is too young for safe determination. It is badly contracted and chiefly characterized by its large eyes, wide mantle opening extending well past the eyes, and short arms, the third and fourth pairs being the longest. The specimen was at first referred to *Bolitæna*, but is more probably an *Eledonella*.

	mm.
Total length	15
Length of mantle (dorsal)	10

From *Albatross* station 4039, 670 to 697 fathoms, off Kawaihae Light, Hawaii [S. S. B. 210].

Family POLYPODIDÆ Hoyle 1904.

Octopidæ (pars) d'Orbigny 1838, p. 3; 1845, p. 164.
Octopodidæ H. and A. Adams 1853, vol. 1, p. 18.
Polypodidæ Hoyle 1904, p. 14.
Polypodidæ Naef 1912b, p. 197.

Animals of small to gigantic size. Body short, thick, and usually firm and muscular. Sexes nearly similar. Ventral mantle connection consisting of a pair of shallow folds on the hinder margin of the funnel, with shallow grooves to correspond on the inner surface of the mantle. No aquiferous pores. Arms with one or two rows of suckers and a more or less well-developed basal web. Hectocotylus confined to the extreme tip of either the right or left third arm; a narrow groove or fold in the edge of the marginal membrane terminates in a roughly spoon-shaped copulatory organ at the extremity.

Genus POLYPUS Schneider 1784.

Polypus Schneider 1784, p. 116.
Octopus Lamarck 1799, p. 18 (*fide* Hoyle).
Octopus d'Orbigny, in d'Orbigny and Férussac 1838, p. 17.
Octopus Hoyle 1886, p. 74.
Polypus Hoyle 1901, p. 1–5.

Body short, thick, rounded posteriorly; surface smooth to warty, usually with one or more tubercular cirri over either eye. Arms and umbrella very variable; suckers in two alternating rows, which are perhaps better to be regarded as a single extremely zigzag row. Third right arm hectocotylized.

Type.—Sepia octopodia Linné 1758, a European species perhaps identical with *P. vulgaris* (Lamarck 1799). Schneider designates no type and does not even name a species, but the inference seems clear that the *Sepia octopodia* of Linné is the form which he had in mind, especially since at that time this was the only species of the group which had been characterized by a binomial name. Hoyle, however, arrives at the conclusion that *Octopus vulgaris* Lamarck 1799 is available as the generic type.

Polypus hawaiiensis (Souleyet 1852).

Octopus hawiiensis Souleyet in Eydoux and Souleyet 1852, p. 9, pl. 1, fig. 1–5.
Octopus Hawaiiensis Tryon 1879, p. 118, pl. 34, figs. 44, 45 (after Souleyet).
Octopus hawaiensis Hoyle 1886, p. 9, 220 (merely listed).
Polypus hawaiiensis Berry 1909, p. 418 (merely listed).

The original description of this species by Souleyet is verbatim as follows:[a]

"*Octopus, corpore rotundato, lævi; capito magno; brachiis crassis, basi palmatis.*

"Corps petit, globuleux, lisse dans toute son étendree, l'ouverture anterieure du sac ne comprenant pas tout à fait la moitié de la circonférence; l'entonnoir assez long et grêle.

"Tête volumineuse, aussi large que le corps.

"Bras très-forts, proportionellement au volume du corps, et légèrement palmer à leur base; ceux des première, troisième et quatrième paires (1), presque egaux en longueur (quatre fois la longueur du sac); ceux de la deuxième paire, d'une longueur un plus grande; les ventouses atternes peu elevees et très-rapprochées.

"Ce poulpe offere partout une teinte d'un gris bleuâtre, très-finement pointillée de noir, ce qui fait paraitre sa couleur noirâtre; cette couleur est moins foncee en dessous du sac et surtout à la partie inférieure de la tête.

"Il provient de Hawaii, l'une des îles Sandwich; il ne parait pas très-commun das cette localité, car nous n'en avons rapporté qu'un seul individu.

Dimensions.

	Centimetres.
"Longueur totale	13
du sac	2
de la tête	1
des bras (1re, 3e, et 4e paires)	8
des bras (2e paire)	10

"Les charactères qui nous ont paru distinguer surtout cette espèce sont: la petitesse, et la forme arrondie du sac, le volume et la longueur mediocre des bras, enfin l'absence de rugosités et d'eminences sur la peau qui est partout parfaitement lisse. Les espèces dont elle se rapproche le plus sont: le *poulpe tehuelche* (O. tehuelchus), de M. d'Orbigny, et *le poulpe brevitentaculé* (O. brevitentaculatus), de M. de Blainville; mais elle diffère de la première de ces espèces par la grosseur et la brièveté des bras, et de la seconde, par la palmature moins considérable de ces appendices et par leur proportion que est tout à fait différente."

Type locality.—Island of Hawaii (Souleyet).

Distribution.—The species has not been again recorded since its discovery.

Remarks.—I am unable to refer any of the numerous specimens of *Polypus* in either the *Albatross* or Stanford collections to this species. Its special characters seem to be the smooth globose body, without cirri or other tubercles, large head, short umbrella, and short robust arms, the second pair of the latter being longest, the others equal. Of the described Hawaiian species, *P. ornatus* and *P. hoylei* are certainly sufficiently distinct, as is also *P. marmoratus* if the description by Souleyet is to be relied upon. The view that the last-named species may really be identical with *P. hawaiiensis* has been suggested by Ortmann (1891, p. 672), and the fact that in the very large series of the genus before me there are no specimens whatever which approximate to the combination of characters alleged to be diagnostic may indicate that an error has somewhere crept in. On the other hand, Tryon regarded *P. hawaiiensis* as very close to or identical with the *Octopus punctatus* Gabb of California, but I think the resemblance is entirely imaginary.

[a] As the original volume has only once been accessible to me, I must here mention my obligation to Dr. E. J. Nolan, of the Academy of Natural Sciences of Philadelphia, for sending me the copy of the above description which is here transcribed.

Polypus marmoratus (Hoyle 1885).[a] (Pl. XLV; pl. XLVIII, fig. 6.)

Octopus marmoratus **Hoyle 1885**, p. 227.
Octopus marmoratus Hoyle 1885a, p. 102.
Octopus marmoratus **Hoyle 1886**, p. 8, 85, 220, pl. 6.
Octopus marmoratus Brock 1887, p. 610, 611.
Octopus marmoratus Ortmann 1891, p. 671.
Octopus marmoratus Joubin ? 1894, p. 35 (*fide* Wülker).
Polypus marmoratus Hoyle 1905, p. 978.
Polypus marmoratus Berry 1909, p. 418 (locality record only).
Polypus marmoratus Wülker 1913, p. 457.

Body of moderate size, rounded pyriform in shape, broadest toward the posterior; not flattened, but with a distinct median longitudinal depression or sulcus on the ventral surface. Integument as a rule quite smooth, but apt to be much wrinkled above, and with a few large, low, longitudinally elongate tubercles on the dorsal surface; notably more conspicuous than the remainder are one of these tubercles at the base of each dorsal arm, one in advance of the center of the head, and a diamond-shaped quadrilateral of four on the dorsum, besides several lateral ones[b]. A series of smaller ridges tends to extend distally from the large tubercles at the base of the dorsal arms out upon the arms, and all show a distinctly bilateral arrangement. In addition to the ridges there is a large conspicuous bluntly conical tubercle just above and behind the center of each eye opening, supplemented by a smaller, more elongated excrescence just in front of the eye, and one other placed diagonally behind. This ornamentation appears to be a reasonably constant feature, at least in the material examined. The mantle opening is not especially wide, extending rather less than halfway from the funnel to the eye.

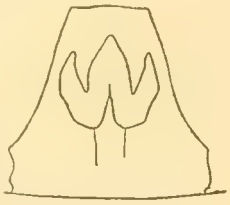

FIG. 13.—*Polypus marmoratus* [175], outline drawing of funnel laid open mediventrally to expose the funnel organ, natural size.

Head rather small, narrow, rounded, separated from the body by an often slight constriction. Eyes prominent. Funnel small, conical, reaching little more than a third of the distance to the umbrella margin. The funnel organ is well developed and comprises a broad bilobate W-shaped pad on the inner wall of the funnel cavity a little forward of the center. (Fig. 13.)

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[a] The principal portion of the description of this species given by Hoyle in the *Challenger* Report (1886, p. 85) is as follows:

"Habitat.—On the Reefs, Honolulu, Sandwich Islands. Three specimens, one ♂, two ♀.

"Sandwich Islands (Copenhagen Museum).

"*The Body* is round, not depressed, and a little longer than wide. The *mantle-opening* extends somewhat less than halfway round the body, terminating nearer to the siphon than to the eye, and considerably behind the latter. The *siphon* is small and acutely conical, and extends about one-third the distance to the umbrella-margin.

"*The Head* is narrow, and the eyes are prominent, where they have not suffered from compression.

"*The Arms* are subequal, eight times as long as the body; they are very long and slender, the last character being more marked in the females than in the male; they taper more rapidly at first than near the extremities, which are much attenuated. The *umbrella* is very wide, especially in the male, where it extends almost one-third up the arms; in the females its extent is only one-sixth. The *suckers* are rather large, and closely set; in the male a few suckers opposite the umbrella-margin are slightly, but not markedly, larger than the others. The extremity of the *hectocotylized arm* is small, and has about 10 small transverse ridges.

"*The Surface* appears to have been smooth, except for a few short ridges placed longitudinally on the back and sides; but the skin is shriveled by the action of the spirit, so that it is difficult to be certain. A conical cirrus is situated above and slightly behind each eye; but in some cases this has been destroyed.

"*The Colour* is a stone-gray, with dark pigment disposed in veins like those of marble on the dorsal surface of the body, head, and umbrella; the male is much darker, so that the marbling is almost concealed. Traces of an oval spot are seen in front of and below the eye on both sides of one female specimen and on one side of the other; but this spot is concealed by the dark colouring in the male even if it exist.

* * * * * * *

"This species presents in some respects a resemblance to *Octopus bimaculatus*, Verrill, namely, in the general form and proportions, in the enlargement of one or more suckers on the lateral arms, and in the small size of the hectocotylus of the male, as also in the presence of the dark spot on either side in front of the eye. Each, too, has a supra-ocular cirrus, but the conspicuously warted upper surface of Verrill's form and the equally marked smoothness of the *Challenger* specimens, as well as the seemingly constant difference of coloration necessitate their separation.

* * * * * * *

"It approaches *Octopus hawaiensis* E. and S., in general form, but differs in the presence of cirri over the eyes."

[b] These structures may very likely represent the "few short ridges placed longitudinally on the back and sides" which are mentioned by Hoyle.

Arms stout and muscular, apt to be heavily recurved and coiled in alcoholic specimens; at first rapidly tapering, but attenuate at the extremities; length moderate, perhaps three to four times that of the body; on the average probably subequal, but variable, in the adult the ventral pair usually a little the longest. Umbrella only moderately developed in the specimens seen; about equal all round, and continued as a prominent contractile web along the outer margins of all the arms. Suckers large, rather flattened, and closely set except along the distal portions of the arms, where the two rows become relatively much more widely separated, a character not shown by the figure in the *Challenger* report; first four suckers at the base in a single row. In the male from two to four suckers opposite the umbrella margin on each arm undergo a slight enlargement.

The third right arm in the male is not very much shorter than its mate and the hectocotylized portion is very small. The calamus is poorly developed and does not show the usual papilliform structure; ligula extremely small, its inner surface excavated and provided with about 10 easily obscured transverse ridges. (Pl. XLVIII, fig. 6.)

Color of preserved specimens everywhere a dull drab or stone gray, lighter below and on the inner surface of the umbrella and arms; dorsally the surface is so heavily clouded with a dark slate as to be almost unicolored, but in the lighter areas and when the folds of the skin are stretched apart the dark pigment is seen to be disposed in narrow anastomosing veins which are here and there very conspicuous.[a] A series of confluent blotches of similar tint extends along the flattened sides of the arms just outside the suckers and in rough alternation with the latter. In well-preserved material there is a large roundish oculation a little way in front of and below the eye on either side; the very dark center is surrounded by a broad ring of lighter tint which is not always easy to make out; the entire spot is often somewhat obscured owing to the heavy pigmentation generally, but as it is conspicuously present in at least one of the male specimens examined, it is clearly not to be looked upon as a sexual character. The color in life is not known.

Beak and radula not examined.

MEASUREMENTS OF POLYPUS MARMORATUS.

Number in author's register	174	175	183	183	183	183	185
Sex	♂	♂	♂	♀	♀	♀	juv.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Total length	?	[a]271	59	68	62	59	45
Tip of body to dorsal base of umbrella	95	56	17	20	16	16	13
Width of body	61	38	11	14	13	12	10
Length of body	.....	.....	12	15	12	11	.....
Width of neck	38	26	8	10	9	8	7
Width across eyes	41	29	11	10	11	10	9
Mouth to tip of right dorsal arm	?	[a]182	37	42	41	40	22
Mouth to tip of left dorsal arm	[a]310	[a]185	24+	40	41	40	21
Mouth to tip of right second arm	[a]340	[a]188	40+	43	46	43	27
Mouth to tip of left second arm	[a]335	[a]190	38	45	45	43	29
Mouth to tip of right third arm	[a]280	[a]165	24	..	44	43	31
Mouth to tip of left third arm	[a]295	[a]195	42	47	49	42	32
Mouth to tip of right ventral arm	[a]345	[a]210	37	35	43	40	29
Mouth to tip of left ventral arm	[a]340	[a]215	39	41	45	40	30
Length of hectocotylus	4	1.5	...	...	.....	...	.....
Length of umbrella between dorsal arms	..	26	6+	13	11	10	4
Length of umbrella between ventral arms	.	26	8	8	7	10	4
Length of funnel	40	20	5	6	5	5	4.5

[a] Largely estimated, but figures given for what they may be worth.

	mm.
Total diameter of ocular spot, right side (S. S. B. 175)	12
Total diameter of ocular spot, left side (S. S. B. 175)	11
Diameter of dark center of spot, right side (S. S. B. 175)	8

[a] From this feature arises the significance of the name *marmoratus*.

Type.—In the British Museum (Natural History).

Type locality.—"On the Reefs, Honolulu, Sandwich Islands;" three specimens (*Challenger* expedition).

Distribution.—Honolulu Reef, Oahu (*Challenger, Albatross*, etc.); Hilo, Hawaii (Stanford University collections); Rotuma (Hoyle); Rimatara (Wülker); Buka, Solomon Islands (Wülker); Stewart Islands (Wülker); Amboina (Joubin); Ceylon (Ortmann).

Material examined.—The following 13 specimens have been examined, the majority of them being rather immature:

No. of specimens.	Locality.	Collector.	Sex.	Where deposited.	Author's register.
1	Honolulu, Oahu	Market	♂	Stanford Univ. Coll., Cat. 2089	174
1	Honolulu, Oahu	Jordan and Evermann	♂	Stanford Univ. Coll., Cat. 2088	175
6	Honolulu Reef, Oahu	Albatross	2 ♀ 4 Juv.		185
4	Honolulu Reef, Oahu	Albatross	1 ♂ 3 ♀		183
1	Henshaw's Road, Hilo, Hawaii		Juv.	Stanford Univ. Coll., Cat. 2090	181

Although *P. marmoratus* appears to be a well marked, even if in no way an extraordinary species, it nevertheless exhibits a considerable measure of variability. The four young individuals from Honolulu Reef (S. S. B. 183), which I have assumed to be referable here, indicate this to a remarkable degree, and it may be possible that they are incorrectly determined; they possess a wide flattened head, pale coloration, no ocular markings, and the skin varies from a nearly smooth state to one where the scattered papillæ are erect and bristling. The numerous small chromatophores render the surface finely punctate, and a single slightly zigzag row of somewhat larger chromatophores extends along the outer surface of each arm. The male in this lot is readily distinguishable by its small but well-developed hectocotylus, and by the rather conspicuous enlargement suffered by the seventh and eighth suckers on each of the lateral arms. The remaining suckers are rather small, a little elevated, and equidistant as in the females. The measurements are surprisingly constant, as shown in the above table.

Hoyle compares this species with the Californian *P. bimaculatus* (Verrill) and apparently with justice, although he is undoubtedly correct in regarding the two as distinct. Specimens of the two species placed together have an entirely different aspect and are not likely to be confounded. The divergent pigmentation alone is entirely sufficient for the ready separation of most specimens, and so far as my very limited experience shows the elongate cirri of many *P. marmoratus* do not appear on the Californian form, although the symmetrical arrangement of the tubercles is much the same.

Ortmann (1891, p. 672) has suggested that Hoyle's species may after all be identical with *O. hawaiiensis* Souleyet, in which case the latter name has many years priority and would of course take precedence, but for the present the matter must go over unsettled.

One of the *Challenger* specimens, which is the largest example of the species so far recorded, has a total length of 630 mm. The species is apparently an abundant littoral form occurring in large numbers on the reefs, and is one of the most important of the species used as food. As the most common of the *Polypi* it is likely to be met with in almost any general collection from the region. It is readily distinguishable from the species which usually accompany it by its somber coloration, ridgelike cirri, moderate arms, small hectocotylus, and wide funnel organ, as well as the presence of the three cirri over the eyes and the oculations at the base of the third arms. Being a solid and muscular species, the tissues, particularly of the arms, are apt to undergo a powerful contraction when preserved in alcohol.

Polypus ornatus (Gould 1852).[a] (Pl. XLVI.)

Octopus ornatus Gould 1852, p. 476, figs. 590, 590a.
Octopus ornatus Tryon 1879, p. 112, pl. 30, figs. 29, 30 (after Gould).
Polypus ornatus Berry 1909, p. 418 (locality record).

Body of moderate size, subglobose, more expanded and rounded posteriorly. Mantle opening simple, moderately wide, extending on either side to a point about halfway between the eye aperture and the funnel.

Head fairly large, rounded, not excavated above or below; the eyes fairly prominent, with small openings; head and body separated in the nuchal region by a decided constriction. Funnel long, extending for about two-thirds of the distance to the ventral margin of the umbrella, conical and tapering, with a broad base; adherent to the ventral surface of the head for more than half its length; aperture small. Funnel organ well developed, comprising a large W-shaped pad lying nearly midway of the dorsal wall; the median lobe is decidedly longer than the lateral wings. (Fig. 14.)

Arms extremely long, very graceful (pl. XLVI, fig. 1), dorsal pair perhaps as much as seven times the length of head and body taken together, extremely slender and attenuate, the tips almost filiform; disproportionately unequal, the order of length 1, 2, 3, 4; dorsal arms conspicuously the stoutest and longest, the remaining arms exhibiting a decided but very regular decrease in size as we progress ventrally; the ventral arms very slender, less than three-fifths as long as the dorsal pair. Umbrella of small extent; best developed between the dorsal arms and least ventrally, thus giving the mouth the apparent position noted by Gould; it is continuous with a loose, very narrow fold of membrane which runs distad along the outer margins of the arms for a short distance, soon becoming nearly or quite obsolete. Suckers of moderate size, somewhat elevated, and with discoid but fairly deep cups; very numerous and somewhat crowded, 312 being counted on the left dorsal arm of the medium-sized specimen without the aid of a lens, less than a third of them occurring on the distal half of the arm; they are consistently in two rows even at the base near the mouth and at the extreme tip as well; a conspicuous maximum in size is attained a little distance beyond the margin of the umbrella. Third right arm in the male about a third shorter than its mate of the opposite side; on this arm a shallow marginal fold incloses a groove running along the outer ventral angle of the arm; this fold is barely distinct from the main body of the arm itself and is the sole remaining vestige of the marginal web; beginning at the umbrella margin, it terminates in the hectocotylus as the median groove of the flattened conical basal papilla (calamus) of the latter; the principal portion of the hectocotylus (ligula) is a conspicuously thick-

[a] The original description of Gould (1852, p. 476) is as follows:

"Body subglobose, the length exceeding the breadth about one-twelfth. Head two-thirds as long as the body, and about half its breadth, of nearly equal width throughout, the eyes being but very slightly prominent. Inferior opening broad, the lip transverse and simple; eyes small, the pupil black, with a silvery iris. Mouth small, situated at the lower third of the umbrella, which is rather small, but well-marked, the membrane not prolonged up the arms. Arms compressed, long and slender, attenuated to a thread, comparative length 2, 4, 3, 1, differing much in size, the upper ones being very robust, the second, third, and fourth pairs being successively more slender, the latter being remarkably slender, not half the size of the upper ones. Cupules of medium size, nearly sessile, crowded, very numerous, extending to the tips of the arms; they commence in a double series on the upper arms, while on the lower ones the first six are in a single series. The surface is coarsely reticulate-papillose, with a series of oblong-oval, smooth, and colorless patches along the back of the arms and around the sac, somewhat resembling bullæ. The ground color is deep orange; beneath somewhat clouded with white; above variegated with five longitudinal, buff stripes, the median one extending to between the eyes, the two lateral ones curving on each side, like meridian lines, and extending only to the neck; between these lines, around the middle of the sac, are deep brown patches, and also between the bases of the arms; there are also brown mottlings along the back of the arms. These, with the pale, bubble-like patches around the base of the sac and along the arms, give a very gay and diversified coloring.

"Length of sac to inferior opening, one and a half inches; length along the back to the umbrella, two and a half inches; breadth of sac, one and three-fourths inches; breadth of neck, one inch; breadth of umbrella from side to side, three inches; breadth above mouth, two inches; below mouth, one inch; length of arms, upper pair, twenty inches; upper lateral, twenty-four inches; lower lateral, about twenty inches; lower pair, twenty-one inches.

"Obtained at the Sandwich Islands at Oahu and Maui.

"No other described species approaches [to] this in form and coloration, except *O. macropus* Risso. The comparative length of arms is different (1, 2, 3, 4), the body is more elongated, and there are no cirrhi about the eyes in the latter species, besides a sufficiently well-marked distinctness of coloration. Described from specimens preserved in spirits, and from a coloured drawing."

ened and expanded spoon-shaped organ, its inner surface broadly but not abruptly excavated and ornamented with numerous irregular transverse wrinkles or grooves. (Pl. XLVI, fig. 2, represents the hectocotylus of an immature specimen.)

The surface ornamentation is very distinctive. Body nearly smooth below; above coarsely and irregularly papillose, the papillæ ordinarily arranging themselves in fairly distinct longitudinal lines, most noticeable on the nuchal region, but extending anteriorly over the umbrella and posteriorly over the dorsum before becoming obsolete. Certain of these papillæ are larger than the others, and in preserved specimens they often become confluent with one another in certain regions of the body to form narrow elongate ridge-like folds of great permanency; along the median line are three of these folds, one extending back from the nuchal region for about a third the length of the body, the second some distance posterior to it in the same line, but much shorter, and a third still farther back and representing but little more than a single large papilla. Lateral to these are three series of similar ridges; two short ones, which, in conjunction with the two chief median ridges, inclose a dark quadrangular area in the middle of the dorsum; two longer folds external to these and paralleling the anterior median fold; and outside these, two still longer but more or less interrupted ridges extending from the upper edges of the mantle opening well past the middle of the body. There are three rather small bluntish cirri just above each eye opening.

FIG. 14.—*Polypus ornatus* [179], outline drawing of funnel laid open medioventrally to expose the funnel organ, natural size.

Color of specimens preserved in alcohol a dull buff, much clouded above with a more or less washed out reddish chocolate, and below with dull ocher or a livid brown. Each of the integumentary ridges which have been described is inclosed in a prominent band of buff, and a conspicuous series of areolæ or reticulations of the same pale tint are disposed in pairs along the outer surfaces of the four dorsal arms for the greater portion of their length. Gould states the general ground color of the living animal to be orange, but in alcoholic material this fades, and in some specimens the buff bands and areolæ may appear not lighter (as in the specimen to which particular reference is had above), but actually darker and brighter than the surrounding integument. The chromatophores are excessively small and copiously distributed.

MEASUREMENTS OF POLYPUS ORNATUS.

Number in author's register	382	179	179
Sex	♂	♂	♂
	mm.	*mm.*	*mm.*
Total length	[illegible]+	520	263
Tip of body to dorsal base of umbrella	97	61	38
Length of body (dorsal)	68	40	24
Width of body	57	40	25
Width of neck	35	25	17
Width of head	35	28	19
Length of—			
Right dorsal arm	540	305+	224
Left dorsal arm	553+	465	225
Right second arm	415	360	175
Left second arm	480	375	186
Right third arm	234	175	112
Left third arm	380	310	155
Right ventral arm	365	260	126
Left ventral arm	380	270	132
Umbrella between dorsal arms	56	27	21
Umbrella between ventral arms	34	15	13
Hectocotylus	9	2	0.5
Diameter of largest sucker	9	5	3
Length of funnel	40	28	17
Width of mantle opening	38	23	15

Type locality.—Oahu (first locality mentioned), Hawaiian Islands (Wilkes expedition).

Distribution.—Hawaiian Islands: Oahu (Gould); Honolulu Reef, Oahu (*Albatross*); Maui (Gould).

Material examined.—Three specimens, all males, are in the *Albatross* collection. All are in an excellent state of preservation.

No. of specimens.	Locality.	Collector.	Sex.	Author's register.
2	Honolulu Reef, Oahu	Albatross expedition	♂	179
1	Honolulu market	do	♂	382

Remarks.—The above description is drawn throughout from the specimens taken by the *Albatross*, special reference being had to the larger of the two individuals collected on the reef, as the large market specimen did not come into my hands until afterward and has been chiefly utilized in preparing the description of the hectocotylized arm. It will at once be noted that there are several rather astonishing discrepancies between these specimens and Dr. Gould's description. Perhaps the most important of these is the relative length of the arms, which Gould states to be 2, 4, 3, 1, an utterly different formula from that shown by the present material. As the quantitative differences between the arms of the respective pairs seem altogether too great for such variations to be due to inequalities in the methods of preservation, I am at a loss to account for the discrepancy. It is of course possible that an error has crept in somewhere, for the *Albatross* specimens show not the slightest evidence of any abnormality, while Gould's account of the consecutive diminution in bulk of the arms is entirely in accord with the condition I have described, though not at all what would be expected were his statement of their relative order of length correct. It may be that the type specimen was possessed of some unobserved defect, for where the arms are so slender as in the present species a mutilated and regenerating extremity might be readily overlooked were not special care taken to the contrary. The peculiarly definite color pattern is in all the specimens as striking as Gould's careful description would imply and is so utterly unlike that of any other *Polypus* known to me that I think there can be no doubt as to the correctness of the identification.

Granting this correction in the arm formula, it is interesting to note that the resemblance of this species to the *Polypus macropus* (Risso) becomes even more close than Gould supposed and extends even to such structures as the hectocotylus and funnel organ. (Cf. Jatta, 1896, pl. 23, fig. 8.) A comparison with the figures cited shows that the two species are throughout essentially similar in structure and indicates a very close degree of relationship. The geographical distribution of both forms yields additional strong evidence toward the same conclusion and further supports the idea that *P. macropus* is in fact the parent form. Although *ornatus* is thus far known only from the Hawaiian Islands, *macropus* has a remarkably wide and continuous range, extending from the Mediterranean, on the one hand, through the Red Sea and Indian Ocean to the Malay Peninsula and even to Japan, where it is still a hardy and abundant species Small differences between the two are numerous and constant, but perhaps are in no way different from the inevitable changes which should be expected to take place in the island species during the long sojourn which it must have had in so isolated an environment. It is curious that the color pattern and surface ornamentation are the features which have undergone the most extensive modification.

Polypus hoylei Berry 1909 (Pl. XLVII, fig. 1; Pl. XLVIII, fig. 2–4; Pl. LV, fig. 1.)

Polypus hoylei Berry 1909, p. 407, 418, text fig. 1.

Body pouch shaped, rounded, more or less depressed above and below, about as long as broad, widening posteriorly and with an obscure longitudinal groove forming an incipient superficial division of the ventral region into halves. Mantle loose and semigelatinous, very soft to the touch; at

first sight nearly smooth, but upon careful examination revealing a fine regularly granulose papillation, most obscure ventrally. Some examples show indications of low tubercles or cirri on the body, but the only structures of this nature which appear to be at all constant are two soft prominent papilla-like excrescences situated over each eye, one placed just in advance of the eye opening, the other at a slightly greater distance behind this point; when in a state of retraction these eminences are reduced to rounded tubercles having a pore-like pit or indentation at their apex. (Pl. XLVIII, fig. 3.) Mantle opening very small, semicircular, closely embracing the base of the funnel, from which, however, it tends in preserved material to contract away, exposing even the basal folds of the latter. (Pl. XLVII, fig. 1.)

Head large, broad, flattened; separated from the body in the nuchal region by a slight lateral constriction. Eyes large, the integument covering them being usually much puckered about the rather small opening. Funnel large and of robust outline, but short, broad, compressed; broadly adherent above to the head and bound to the latter by loose folds of the integument even as far forward as the basal portion of the umbrella; its extremity is free and reaches a little less than half way to the margin of the latter. Funnel organ well developed and of a very distinctive type; it comprises two narrow but conspicuous V-shaped pads lying on the dorsal inner wall of the funnel cavity, near the tip; they are entirely similar to one another and unconnected. (Text fig. 15, also pl. XLVIII, fig. 4.)

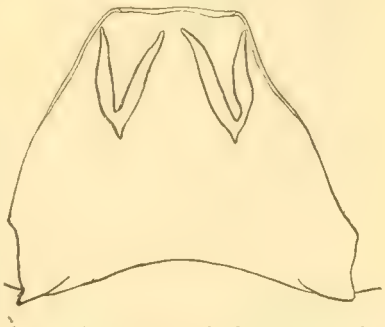

FIG. 15.—*Polypus hoylei* [176], outline drawing of funnel laid open medioventrally to expose the funnel organ, × 2.

Arms quite short for a *Polypus*, only about two to two and one-half times as long as the head and body; stout, rapidly tapering, the extremities little attenuate; dimensions nearly equal, but exhibiting considerable variability, the third pair apt to be slightly the shortest; connected at base by a wide semitransparent membranous umbrella, extending between the arms about equally all round for from one-third to nearly one-half of their length, but usually of slightly less extent ventrally; this interwebbing is continuous with a conspicuous fleshy fold which extends along the outer margins of all the arms to their extremities. Suckers moderately large, numerous, closely set; regularly alternating in two rows, except at the base, where the first three appear in a single row; soft, but well separated; moderately elevated. According to my observations none of the suckers in the male show any appreciable enlargement or other differentiation one from another. (Pl. LV, fig. 1.)

Third right arm in the male notably shorter and stouter than its mate of the opposite side and prominently hectocotylized, the modification affecting only the tip of the arm and the usual sperm canal formed along the edge of the marginal membrane. The organ at the tip is bluntly conical, somewhat spoon shaped, and the broad excavation on its inner face scarcely or not at all ridged; such ridges, if they occur at all in the larger specimen are rendered very obscure by the loose consistency of the integument, and in the smaller male one or two transverse grooves only may be made out. The relative measurements of the hectocotylus are given in the table of measurements below. With age the ligula becomes apparently somewhat more elongate, as in the smaller male it is very short and pyramidal. The sperm canal terminates distally in the usual basal papilla or calamus, which is here acutely conical, with its inner surface deeply grooved. (Pl. XLVIII, fig. 2.)

Color of preserved specimens a brownish red above, slightly paler or more pinkish below and on the inner surface of the umbrella; no definite color pattern or even any mottlings or other ornamentation of the sort. Entire surface closely punctate with small round reddish brown chromatophores, especially on the dorsal aspect, where they are largely distributed in veins or obscure cloudings, the interstices between which appear as pale reticulations or marblings against a darker background, a feature scarcely to be distinguished without carefully and firmly smoothing out the skin by the fingers.

MEASUREMENTS OF POLYPUS HOYLEI.

Author's register	166	176	178	177
Sex	♂ (type.)	♂	?	♀
	mm.	*mm.*	*mm.*	*mm.*
Total length	233	127	108	148
Tip of body to base of umbrella	65	41	41	54
Width of body	45	31	28	26
Width of neck	36	27	26	22
Width of head	41	30	27	24
Length of—				
Right dorsal arm	109+	89	71	91
Left dorsal arm	111+	88	76	49+
Right second arm	[a] 161+	89	76	105
Left second arm	172	82	75	62+
Right third arm	116	75	22+	86+
Left third arm	158	78	66	93
Right ventral arm	104+	85	74	80
Left ventral arm	159	85	75	79
Hectocotylus	6.5	2	.....	.....
Umbrella between dorsal arms	42	30	20	20
Umbrella between ventral arms	41	36	15	17
Diameter of largest sucker	3	2	2	2
Length of funnel	18	17	12	15
Width of mantle opening	22	18	16	16

[a] Through an inadvertence the length of this mutilated arm was given in the original description as that of the second arm pair. In the above table the measurements of all the arms were taken along the inner surface from the mouth to the tip. The umbrella was measured externally.

Type.—Cat. no. 214310 United States National Museum [S. S. B. 166].

Type locality.—Hawaiian Islands (*Albatross*); the exact locality and other data are unknown as this specimen was unfortunately not accompanied by any label when it came into my hands.

Distribution.—Among the Hawaiian Islands, in the archibenthal region (*Albatross*).

SPECIMENS OF POLYPUS HOYLEI EXAMINED.

No. of specimens.	Locality.	Depth in fathoms.	Collector.	Sex.	Where deposited.	Author's register.
[a] 1	Hawaiian Islands	?	Albatross	♂	U. S. N. M. Cat. 214310.	166
1	Kaiwi Channel, between Molokai and Oahu.	449–460	Albatross station 4110	?	.....	178
1	Vicinity of Kauai Island	283–309	Albatross station 4130	♂	.....	176
1	.....do	257–312	Albatross station 4132	♀	.....	177

[a] Type.

Remarks.—*P. hoylei* appears to be a characteristic member of the deeper water fauna of this region. Finding no close ally among its neighboring congeners, it is conspicuously characterized by its pale color, soft consistency, unusually small mantle opening, fine surface papillation, short arms, stout hectocotylized arm, and the very unusual shape of the funnel organ. I had originally thought that this species might be a near relative of *P. januarii* (Steenstrup), but a reconsideration of the admirably full description of the latter in the *Challenger* Report has led me to believe that the alliance is not especially close. Both are of deep-water habit and such resemblance as exists between them may well be due to coordination with a similar environment. *P. hoylei* bears a certain resemblance to some of the published figures of *P. sponsalis* (P. and H. Fischer) and one or two similar forms, but it is, I think, sufficiently distinct.

Altogether it is an unusually attractive and interesting species. The specific name is in honor of that master student of cephalopods, Dr. William Evans Hoyle.

[**Polypus fontanianus** (d'Orbigny 1835).]

Octopus fontanianus d'Orbigny 1835, p. 28, pl. 2, fig. 5.
Octopus fontanianus Tryon 1879, p. 123, pl. 37, fig. 54 (after d'Orbigny).

This species is rather uncertainly listed from the "Sandwich Islands" by Tryon (l. c., p. 124) on the authority of a specimen stated to be in the collection of the Academy of Natural Sciences of Philadelphia. It is a South American species and hence its occurrence in Hawaii needs a confirmation which it is not likely ever to receive.

As the collections before me are unusually rich in immature individuals of this genus, some of which do not seem referable to any of the named species, I have thought it worth while to present a brief description of each of the various types into which as a rule the specimens may be easily separated.

Polypus α (young).

Polypus a Berry 1909, p. 418 (merely listed).

Two juvenile *Polypi* in the *Albatross* collection agree in the following assemblage of characters:

Body relatively large, ovate, saccular; much inflated, especially below; broadest *anteriorly* and terminating in an obtuse point or nipple-like projection behind. Mantle approximately smooth, with no definite papillæ, tubercles, or cirri; mantle opening wide, extending to just below the eyes.

Nuchal constriction prominent, almost furrow-like. Head short, broad, flattened. Eyes inconspicuous, slightly protruding, with very small apertures. Funnel large, but not reaching to the base of the arms; in shape bluntly conical.

Arms long, slender, attenuate; very unequal, the order of length 1, 2, 3, 4; connected at the extreme base by a short, delicate umbrella of nearly equal extent all around. Suckers small, numerous, crowded, in two rows.

Color of preserved specimens everywhere pale, without markings of any kind.

With one of the two specimens mentioned are two much smaller individuals (about 27 mm. long), which may represent an even younger stage of the same species, but they differ from those described in their shorter, more uniform arms, much larger eyes, and more oval body.

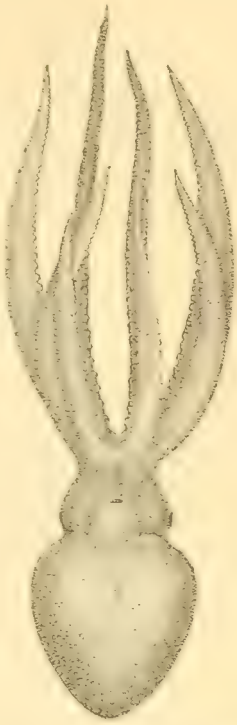

FIG. 16.—*Polypus a* [192], ventral view of immature specimen from station 3843, × 2. Drawn by R. L. Hudson.

MEASUREMENTS OF POLYPUS α.

Number in author's register	191	192	Number in author's register	191	192
	mm.	*mm.*	Length of—	*mm.*	*mm.*
Total length	56	45	Right second arm	34	28
Tip of body to base of dorsal arms	18	15	Left second arm	33	25
Length of body (dorsal)	14	11	Right third arm	29	21
Width of body	11	9	Left third arm	29	22
Width of neck	6.5	6	Right ventral arm	25.5	17
Width of head	8	7	Left ventral arm	25	17
Length of—			Umbrella between dorsal arms	5	3
Right dorsal arm	38	30	Umbrella between ventral arms	4	2
Left dorsal arm	38	25+	Funnel	6	5.5

SPECIMENS OF POLYPUS α EXAMINED.

No. of specimens.	Locality.	Depth.	Collector.	Author's register.
3	Off Diamond Head Light, Oahu	Surface	Albatross station 3921	191
1	Off South coast of Molokai	do	Albatross station 3843	192

Remarks.—The long, graceful arms give this curiously shaped little *Polypus* a most characteristic spidery appearance. As already indicated, the specimens bear all the evidences of immaturity, and I think there is good evidence that they are but the young of *P. ornatus*, the adult of which they resemble in their arm formula and short umbrella. However, as this is not quite certain and they have so unique a facies of their own, it has seemed best to give them provisional consideration by themselves. In recalling the discussion I have given on a preceding page regarding the relationships of *P. ornatus*, it is interesting to note that these young individuals are exceedingly suggestive of the young of *P. macropus* (Risso) as figured by Jatta in his Naples monograph (1896, pl. 24, fig. 2). Should my belief that these are juvenile *ornatus* be correct, another striking bit of evidence of the close affinity of that species with *P. macropus* is afforded.

Polypus β (young). (Pl. XLVIII, fig. 7, 8.)

Polypus β Berry 1909, p. 418 (merely listed).

Body compact, slightly longer than broad, little tapering, squarely rounded posteriorly; flattened above, more inflated below, with a distinct longitudinal sulcus in the middle, and sometimes a curved constriction or groove nearly paralleling the mantle margin and just behind it. Surface almost smooth, but the dorsum very faintly and regularly papillose, especially between the eyes; just above and a little posterior to each eye opening is a small blunt tubercle, with one or two fainter ones sometimes to be distinguished near it. Mantle opening wide, reaching nearly to the eyes.

Head short, broad, compressed, flattened above. Eyes moderately large and prominent. Funnel short, bluntly conical; barely reaching to the base of the arms; broadly adherent above to the head for a large part of its length.

Arms robust, little attenuate; very short, but about half again as long as the head and body; nearly equal, the dorsal pair as a rule slightly the shortest. Umbrella well developed, but only about half as long dorsally as ventrally and attaining its maximum between the arms of the third and fourth pairs, along which it reaches for about one-third of their length; marginal membranes present on the arms as continuations of the umbrella, but much reduced and almost keel-like. Suckers numerous, large, slightly elevated; closely placed, the first two to four in a single row, the remainder alternating and biserial.

Ground color everywhere a brownish buff, rather pale, but closely dotted above with numerous minute slate-colored chromatophores. A double row of very large, irregular, chevron-shaped chromatophores extends from the base along the outer surface of all the arms, but early becomes obscure on the two ventral pairs. In very young individuals (of a length of 12 mm. or less) the ventral surface of the mantle is ornamented by a number of large irregularly ovoid chromatophores arranged in transverse rows, and there is a single very distinct dark-colored series bordering the nuchal constriction. Such specimens are apt to be a little more globose than those further advanced.

MEASUREMENTS OF POLYPUS β.

Author's register	190	196	193	197	Author's register	190	196	193	197
	mm.	*mm.*	*mm.*	*mm.*	Length of—	*mm.*	*mm.*	*mm.*	*mm.*
Total length	51	36	24	10	Left second arm	29	19	13	4
Tip of body to base of dorsal arms	19	15	10	6	Right third arm	29	19	14	4
Length of body (dorsal)	15	12	9	5	Left third arm	32	21	14	4
Width of body	12	12	9	3.5	Right ventral arm	31	19	14	4
Width of neck	11	10	8	3.5	Left ventral arm	31	19	14	4
Width of head	12	14	9	3.5	Umbrella between dorsal arms	5	4	.....	1
Length of—					Umbrella between ventral arms	10	8	.....	2
Right dorsal arm	28	21	13	3	Diameter of largest suckers	1.5	1+	1	.....
Left dorsal arm	28	20	13	3	Diameter of mantle opening	10.5	9	.....	3
Right second arm	29	19	14	4	Length of funnel	7	5	.....	.....

Material examined.—Specimens exhibiting essential accord with the above description were very commonly taken by the *Albatross* in surface hauls. In all some 15 individuals are to be recorded.

SPECIMENS OF POLYPUS β EXAMINED.

No. of specimens.	Locality.	Depth.	Collector.	Author's register.
1	Off Lae-o Ka Laau Light, Molokai	Surface	Albatross station 3821	194
1	.....do	.....do	Albatross station 3837	202
2	Off Kalaupapa, Molokai	.....do	Albatross station 3905	200
1	Off Diamond Head, Oahu	.....do	Albatross station 3907	201
1	.....do	.....do	Albatross station 3911	193
1	.....do	.....do	Albatross station 3912	196
2	.....do	.....do	Albatross station 3921	195
1	Honolulu Reef, Oahu	Shore	Albatross expedition	184
1	Between Honolulu and Laysan Island	Surface	Albatross station 3926	199
1	.....do	.....do	Albatross station 3930	190
1	Between Honolulu and Kauai	.....do	Albatross station 3980	198
2	Between Kauai and Oahu	.....do	Albatross station 4011	197

Remarks.—The series of small *Polypi* now under discussion has been the occasion for no little perplexity, especially since it seemed natural to suppose that a species of such apparent abundance ought to be represented in a collection of this size by adults as well, even though I have been utterly unable to bring about such an identification. The more salient characters which separate these specimens, even at a glance, from the other juveniles before me, are the comparative shortness and equality of the arms, the great development of the umbrella, faint papillation, and the prominent chevronlike chromatophores on the arms. It might be safe to propose a new specific name for this form, but in view of the lack of adult material and the unfortunate uncertainty which attaches to *P. hawaiiensis*, it seems the part of wisdom to refrain from adding another name to this already overburdened genus.

Polypus γ (young).

Polypus γ Berry 1909, p. 418 (merely listed).

Several specimens have a different aspect from anything thus far dealt with. The largest of these is the best preserved and may be briefly described as follows:

Body bag-shaped, rather elongate, widest near the middle, without any very prominent ventral groove; length exceeding the width by about one-half. Surface densely papillose above, but nearly smooth below; the papillæ extend thickly over the dorsal aspect of the mantle, head, and umbrella as well as the outer surface of the first two pairs of arms and the dorsal half of the outer surface of the third; they are nearly equal in size, but on the body become longitudinally elongate and appear to be ranked in more or less irregular longitudinal rows, some of them occasionally tending to coalesce to form short

ridges which are usually bilaterally arranged on either side of the body. The most conspicuous of these ridges are two median and two lateral ones, which between them inclose a diamond-shaped space on the dorsum similar to that already described for *P. marmoratus*. There is also a large blunt tubercle above and just behind the center of each eye opening, but this is often so flattened in preserved specimens as to be quite obscure. Mantle opening wide, extending for a little more than half the circumference.

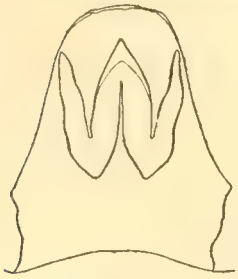

FIG. 17.—*Polypus γ* [180], outline drawing of funnel laid open medioventrally to expose the funnel organ, × 2.

Head large, elevated, rounded, slightly flattened above. Eyes prominent, with rather large openings. Funnel small, conical; aperture narrow. Funnel organ W-shaped (fig. 17).

Arms moderate, about twice as long as the head and body together; connected at the base by a fleshy umbrella which is best developed between the ventral arms, extending between them for about a quarter of their length; subequal, except the dorsal pair, which are a little the shortest, the order of length 3=4=2, 1; marginal membrane well developed. Suckers rather large, elevated, the first two or three in a single line, the remainder placed moderately close together in two alternating rows.

Chromatophores few below; extremely numerous on the dorsal surface where they appear as exceedingly fine dark punctations. Color in alcohol brownish gray, heavily clouded above with a somewhat darker shade. A very dark stripe borders the upper margin of each arm, while a broad triangular area of a pale color just includes the ocular aperture within its apex and is bounded dorsally by a dark wedgeshaped stripe in front of the eye and a similar one just behind, an arrangement which may be roughly represented by the use of a diagram (fig. 18). There are no ocular markings.

The youngest specimen seen (station 3849) differs from that just described in that a few scattered chromatophores are evident on the ventral as well as the dorsal surface, and certain others are evident as two extremely regular rows of distinct round dots extending along the outer surface of each of the four ventral arms; on the arms of the third pair, however, the dorsal row is almost completely hidden by the prevailing dark coloration. In a somewhat larger individual (station 3905) this peculiar arrangement of the chromatophores is still to be made out but has become much more obscure. Both these specimens have a wider head and more globose body than the larger one above described.

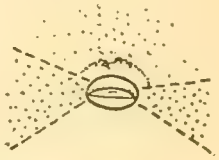

FIG. 18.—*Polypus γ*, diagrammatic representation of color pattern in region of left eye of specimen from Honolulu [180].

Another specimen taken on the reef at Honolulu by Dr. Jenkins is probably the same, the numerous small differences being apparently due to the better preservation of the *Albatross* material. The papillæ are here considerably less prominent so that their arrangement is more difficult to determine, and the umbrella is considerably shorter between the ventral arms than it is above.

MEASUREMENTS OF THREE LARGEST INDIVIDUALS OF POLYPUS γ.

Author's register	180	188	203
Sex	♀	♀	♀
	mm.	*mm.*	*mm.*
Total length	143	120	77
Tip of body to base of dorsal arms	46	25	25
Length of body	30	17	18
Width of body	22	17	16
Width of neck	17.5	14	13
Width of head	20	17	14
Length of—			
Right dorsal arm	87	84	31
Left dorsal arm	57+	82	40
Right second arm	95	90	51

Author's register	180	188	203
Sex	♀	♀	♀
Length of—	*mm.*	*mm.*	*mm.*
Left second arm	92	95	48
Right third arm	94	91	50
Left third arm	97	92	47
Right ventral arm	93	88	51
Left ventral arm	96	90	52
Umbrella between dorsal arms	16	18	6
Umbrella between ventral arms	22	15	12
Diameter of largest suckers	3.5	3	2
Diameter of mantle opening	16.5	13	11.5
Length of funnel	13	11	11

SPECIMENS OF POLYPUS γ EXAMINED.

Number of specimens.	Locality.	Depth.	Collector.	Sex.	Where deposited.	Author's register.
1	Honolulu, Oahu	Shore	Wood 1898	♀	Stanford Univ. Coll., Cat. 2091.	180
? 1	Honolulu Reef, Oahu	...do	O. P. Jenkins	♀	Stanford Univ. Coll., Cat. 2092.	188
1	Off Kaluapapa, Molokai	Surface	Albatross station 3905	♀	U. S. Nat. Mus., Cat. 214384	203
1	Off Lae-o Ka Laau, Molokai	...do	Albatross station 3849	♀	Not preserved	172

Remarks.—These specimens are obviously not the young of either *Polypus ornatus* or *P. hoylei.* In some respects they approach *P. marmoratus*, but differ decidedly in coloration, in shape, the absence of ocular markings, and the double row of small chromatophores on the ventral arms of the very young. The funnel organ also appears to be a little different, being narrower and more deeply cleft in the median line. Were it not for the papillated surface and the cirri over the eyes, a relationship with *P. hawaiiensis* might be suggested, but even here these are not the only difficulties. The most conspicuous features of possibly diagnostic importance in addition to those just noted are the short dorsal arms, the subequal dimensions of the remainder, the elongate body, and the relative shortness of the umbrella dorsally. Some of the specimens have a superficial resemblance to *Scaeurgus patagiatus* in a general way, but of course lack the marginal fold and other distinguishing features. As in the latter species, the body is remarkable for its compactness and solid consistency in alcohol.

Polypus δ (young).

A single badly mutilated *Polypus* taken on the reef at Honolulu by Dr. O. P. Jenkins and now in the Stanford University collections does not seem clearly identifiable with any of the other forms which have been discussed. It is chiefly characterized by its small ovoid body, smooth save for a few small isolated papillæ; broad head; protruding eyes, ornamented above by two or three minute cirri; the very scanty umbrella, which is much shorter than in any other Hawaiian *Polypus*, not even excepting *P. ornatus;* short dorsal arms, and the extremely stout and long arms of the third and fourth pairs. The arms of the second pair are both mutilated, but with this exception the order of relative length is 3=4.1. The suckers are fairly large, very numerous, and close set. The color is cloudy black above, pale beneath.

In some respects this specimen recalls *P. ornatus*, but in most ways the aspect is notably different. It is No. 186 of the author's register.

MEASUREMENTS OF POLYPUS δ.

	mm.		*mm.*
Total length	162	Length of—	
Tip of body to base of dorsal arms	22	Left second arm	32+
Length of body	15	Right third arm	37+
Width of body	14	Left third arm	137
Width of neck	10	Right ventral arm	133
Width of head	12	Left ventral arm	140
Length of—		Umbrella between dorsal arms	5
Right dorsal arm	17+	Umbrella between ventral arms	9
Left dorsal arm	71	Diameter of largest suckers	3
Right second arm	17+	Diameter of mantle opening	9.5
		Length of funnel	9

Polypus *ε* (young).

Polypus ornatus (pars) Berry, 1909, p. 418 (locality record only).

Two small *Polypi* taken from a depth of 53–230 fathoms, *Albatross* station 4002, vicinity of Kauai Island, constitute catalogue no. 214,383 of the United States National Museum (S. S. B. 182). They agree in the following characters:

Body small, globose, elevated dorsally; surface obscurely and distantly papillose. Head short and very broad; well separated from the body by a rather deep constriction. Eyes prominent, the aperture to each surmounted by a small conical cirrus and surrounded by a number of more or less distinct smaller papillæ. Funnel of moderate length and width, not quite reaching to the base of the arms.

Arms attenuate; fairly stout, but in appearance slender owing to their great length; in preserved specimens often much tangled and twisted; decidedly unequal, the order of length being 3, 4=2, 1; the third pair vastly the stoutest, largest, and longest, attaining a length of over six times that of the head and body. Suckers small, elevated, little flattened; numerous and closely crowded in each row, but the two rows themselves placed quite distantly from one another along the margins of the arm, the inner surface of which between them is broad and flattened. The first four or five suckers appear in a single row, but distal to these the biserial condition prevails. Umbrella of moderate width, but thin; continuing along the outer edge of each arm to its extremity as a delicate contractile membrane.

Ground color of preserved specimens dull buff, heavily mottled above with dark brown, which, except for a very irregular blotch or spot on either side of the body, does not appear to be distributed with any special regularity. The outer aspect of the arms is mottled and reticulated. Chromatophores small and numerous.

MEASUREMENTS OF POLYPUS *ε*.

	mm.		*mm*
Total length	88	Length of—	
Tip of body to base of dorsal arms	12	Right second arm	52
Length of body	7.5	Left second arm	53
Width of body	9	Right third arm	59+
Width of neck	6	Left third arm	76
Width of head	8	Right ventral arm	57
Length of—		Left ventral arm	52
Right dorsal arm	37	Umbrella between dorsal arms	4
Left dorsal arm	37	Umbrella between ventral arms	6
		Funnel	5

Remarks.—Upon the first hasty glance these specimens were thought to be young *P. ornatus* and they were originally so reported. Further study has, however, persuaded me that they represent not that species but some other form, the adult stage of which has not yet been obtained. The most distinctive features are the mottled coloration, the extraordinary development of the third arm pair, the wide separation of the two rows of suckers, and the small size of the latter.

Polypus species?

A single specimen obtained by the *Albatross* party from a fish market in Honolulu is represented only by the body and part of the head. It is too mangled for safe determination [S. S. B. 331].

Genus SCÆURGUS Troschel 1857.

Scœurgus Troschel 1857, p. 51.
Scœurgus Troschel 1858, p. 298.
Scœurgus Jatta 1896, p. 53, 230.

Animal very similar to that of *Polypus*, but in the male the third arm of the *left* side is hectocotylized
Type.—*Scœurgus titanotus* Troschel 1857 (first species named), a Mediterranean species.

Scæurgus patagiatus Berry 1913. (Pl. XLVII, fig. 2, 3; pl. XLVIII, fig. 1.)

Scaeurgus, sp. Berry 1909, p. 418 (locality record only).
Scaeurgus patagiatus Berry 1913, p. 564.

Body short, rounded, firm, compact, nearly or quite as broad as long; widest anteriorly or near the middle, evenly rounded behind; much flattened ventrally, with a conspicuous median longitudinal groove; dorsum arched; sides rounded, often flattened or sunken above the periphery in preserved material giving an angular appearance. Mantle opening wide, reaching a little more than halfway between the funnel and eye. Surface (except on the funnel and ventral aspect of the head and arms) everywhere thickly covered with small distinct rounded papillæ or tubercles; on the ventral surface of the mantle they are in the main separate and irregularly but evenly distributed; on the dorsal surface they have a tendency to run together and arrange themselves in more or less irregular longitudinal series, occasionally forming short low ridges similar to those which have been remarked in *Polypus marmoratus*. These ridges also recall those of *P. marmoratus* in their position and frequent bilateral symmetry; four of them form the usual quadrilateral on the dorsum, besides various others more laterally situated. A conspicuous series of similar but less obscure ridges begins a short distance from the base of the arms (affecting all of them except the ventral pair), and extends along their outer surfaces, reaching its maximum on the third pair, where it results in a nearly continuous fold. A narrow keel-like ridge or fold bounds the periphery of the body from a point on either side opposite the base of the funnel nearly to the posterior; in the gap where the resulting lateral folds are discontinuous on the extreme posterior point of the body is a large soft vertical papilla of elongate-conical shape. A large warted or branched papilla is situated obliquely above and behind each eye, with a smaller one just in front and directly over the eye opening.

FIG. 19.—*Scæurgus patagiatus* [205], outline drawing of funnel laid open medio-ventrally to expose the funnel organ, female, × 2.

Head broad, but considerably narrower than the body, from which it is separated by a decided but variable constriction; short, rather small. Eyes large and prominent. Funnel large, conical; broadly adherent above to the head for over half its length, the free extremity reaching about halfway to the umbrella margin. Funnel organ well developed as a broad W-shaped band centering on the dorsal wall of the interior cavity anterior to its center (fig. 19).

Arms robust, squarish, rapidly tapering; of moderate length, but over twice that of the body and head taken together; subequal, the second pair usually a very little the longest. Umbrella well developed, especially between the dorsal arms, where it reaches for nearly one-fourth of their total length; it is continued along the outer margin of each arm to the extremity as a narrow contractile webbing; this membrane appears on both dorsal and ventral angles of the arm, but is invariably widest and most persistent ventrally. Suckers numerous and fairly large; the first two to four in a single row, the remainder quite closely ranked in a double series. In the male one of the suckers on each third arm opposite the margin of the umbrella is obviously larger than the rest.

Third left arm in male a little shorter than its mate of the opposite side and prominently hectocotylized; the conspicuous and ample sperm canal in the margin of the ventral membrane terminates in a long slender acutely conical *calamus*, over one-half as long as the entire hectocotylus; *ligula copulatoria* spoon shaped, its inner surface deeply excavated, nearly smooth, and protected by the heavily incurved margin, which may almost completely inclose the cavity. (Pl. XLVII, fig. 3; pl. XLVIII, fig. 1.)

Color of alcoholic specimens, in general a pale brownish buff, clouded or lightly marbled above with a light chocolate of somewhat varying intensity. Chromatophores small and very numerous, indistinguishable ventrally. Specimens preserved in formalin lose every vestige of pigmentation.

The following notes in regard to the color of this beautiful species during life appear on the reverse of the station label accompanying the type specimen, in the handwriting of Dr. W. K. Fisher: "Ventral surface of body opalescent blue and pink. Light emerald green about eyes. Reddish brown chromatophores on dorsum and sepia ones over eyes. General color of animal when chromatophores are contracted is very pale green."

MEASUREMENTS OF SCÆURGUS PATAGIATUS.

Number in author's register	204 type.	207	208	205	207	206	207
Sex	♂	♀	♀	♀	♀	♂	♂
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Total length	152	136	130	104	97	63	60
Tip of body to base of dorsal arms	46	40	40	31	27	21	23
Length of body	34	31	30	22	20	14	13
Width of body	31	31	28	26	19	15	14
Width of neck	20	20	21	18	13	12	11
Width of head	24	20	22	19	13	13.5	12.5
Length of—							
Right dorsal arm	103	92	87	71	59	40	37
Left dorsal arm	91	93	82+	73	60	40	36
Right second arm	106	93	90	73	59	42	37
Left second arm	100+	96	87	72	52+	30+	36
Right third arm	105	90	88	68	58	42	34
Left third arm	90	89	89	70	55	38	33
Right ventral arm	100	86	84	68	53	40	36
Left ventral arm	100	88	87	69	57	27+	35
Hectocotylus	8	.....	..	.....	.....	.....	.75
Umbrella between dorsal arms	26	25	22	19	16	12	10
Umbrella between ventral arms	13	11	18	13	12	8	8
Diameter of large sucker	4	3	3	2	1.5	1	.....
Diameter of mantle opening	17	18	20	16	11.5	10	9.5
Length of funnel	20	13	15	14	10	10	8

Type.—Catalogue No. 214379 United States National Museum [S. S. B. 204].

Type locality.—*Albatross* station 4079, 143–178 fathoms, bottom of gray sand and foraminifera, off Puniawa Point, Maui, July 22, 1902; one adult male.

Distribution.—Among the Hawaiian Islands in depths of 125 to 165 fathoms as follows: Off Puniawa Point, Maui (*Albatross*); Pailolo Channel (*Albatross*); vicinity of Laysan Island (*Albatross*).

SPECIMENS OF SCÆURGUS PATAGIATUS EXAMINED.

No. of specimens.	Locality.	Depth in fathoms.	Collector.	Sex.	Where deposited.	Author's register.
1	Pailolo Channel	127	Albatross station 3856	♀	.....	205
1	.....do	128–138	Albatross station 3858	♂	.....	206
3	.....do	132–141	Albatross station 4103	♂ 2 ♀	.....	207
1	Off Puniawa Point, Maui	143–178	Albatross station 4079	♂	U. S. Nat. Mus., Cat. 214379	204
[a] 1	Vicinity of Laysan Island	148–163	Albatross station 3938	♀	.....	208

[a] Type.

Remarks.—This superb species is the first representative of the circumscript genus *Scæurgus* to be noted from outside the Mediterranean and the immediately adjacent waters of the Atlantic, so that its occurrence as a common species in the Hawaiian Islands occasioned no little surprise. Not only does the present form belong unmistakably to this genus, but it presents so close an approximation to one of the Mediterranean species—*S. unicirrus* (delle Chiaje)—that the separation of the two has only been accomplished by attention to very small details. I have unfortunately not been able to see any actual specimens of *S. unicirrus*, but to judge from the figures given by Jatta (1896, p. 234, pl. 3, fig. 2; pl. 25, figs. 14–22; pl. 26, figs. 1–3) the body of the latter species is a little more elongate; the funnel organ is somewhat different in shape; and the ornamentation of the integument shows certain dissimilarities, notably in that no ridgelike folds are shown to occur on the dorsum and arms, although indications of such a fold on the third arms of the example figured on plate 26, figure 2, suggests the possibility that their absence in the other figures may be due to insufficient representation. The Hawaiian form also appears

to be slightly the superior in size. The widely separated habitat of the two leads one to believe that as both species become better known numerous other differences will undoubtedly be discovered to exist between them.

Dr. Fisher informs me that when living the animal is an object of great beauty, the sheen of its delicate opalescence approaching that of mother-of-pearl. If it is so common a species in this region, it seems rather remarkable that no member of the genus has been brought to light from any other part of the Pacific.

LARVAL OCTOPOD.

There is a very curious but undetermined larval octopod in the *Albatross* collection from station 3802, 150 fathoms, between the Erben Bank and Kaiwi Channel [S. S. B. 386].

Suborder DECAPODA Leach 1817.

Sephinia Rafinesque 1815, p. 139 (*fide* Binney and Tryon, p. 1).
Decapoda Leach 1817 (*fide* Gray).
Decacera de Blainville 1824 (*fide* Verrill).
Decacera de Blainville 1825, p. 366.
Decapoda d'Orbigny 1845, p. 236.
Decapoda Gray 1847, p. 205.
Sephinia Gray 1849, p. 2, 35.
Decapoda H. and A. Adams 1853, vol. 1, p. 25.
Decapoda Keferstein 1866, p. 1438.
Decacera Verrill 1881, p. 426.

Arms normally 10 in number; the fourth pair originating in special pouches into which they may be more or less completely retractile, and greatly modified to function as highly specialized prehensile organs. Suckers distinctly pedunculate; their apertures equipped with horny or chitinous rings, which may be perfectly smooth, more or less dentate, or with the upper margin greatly enlarged and produced into a long incurved hook. Body short to elongate, rounded or pointed posteriorly, and always with well developed terminal or lateral fins. Head and mantle sometimes continuous in the nuchal region, but more often free and with a cartilaginous articulation. Gladius calcareous or horny; rarely absent; in one genus (*Spirula*) there is an internal coiled and chambered shell. Wherever hectocotylization occurs one or both of either the dorsal or ventral arms undergo the modification.

Highly specialized photogenic organs of many types are of frequent occurrence.

Division MYOPSIDA (d'Orbigny 1845).

Decapoda Myopsidæ d'Orbigny 1845, p. 237.
Myopsidæ Keferstein 1866, p. 1441.
Myopsidæ Verrill 1881, p. 432.
Myopsida Hoyle 1886, p. 16, 110.
Myopsida Pfeffer 1908, p. 15, 24.

Eyes almost invariably covered by a continuous imperforate membrane or foldlike lid. Horny rings of suckers either smooth or dentate, but never falciform.

There are also numerous important visceral characters such as the symmetrically bipartite liver, genital artery springing directly from the heart, etc.

Family LOLIGINIDÆ (d'Orbigny 1845 em.).

Loligidæ d'Orbigny 1845, p. 318.
Loliginidæ Gray 1849, p. 36, 66.
Loliginidæ H. and A. Adams 1853, vol. 1, p. 35.
Loliginidæ Verrill 1881, p. 433.
Loliginidæ Pfeffer 1908, p. 24.
Loliginidæ Naef 1912, p. 243; 1912a, p. 741.

Body elongated and cylindric or cylindro-conical. Mantle free from head in the nuchal region but with a cartilaginous articulation. Eyes without lid-folds, the lens uninterruptedly covered by the outer skin. Fins rhombic to sagittate and terminal, or nearly as long as the mantle and marginal; more

or less acute posteriorly. Left ventral arm of male hectocotylized. Tentacle club with four rows of suckers on the median portion. Horny rings of the suckers usually toothed. Funnel supported dorsally by free muscular bridles; its aperture with a large internal valve. Shell a horny, uncalcified, feather-shaped gladius, comprising a thickened midrib and broad lateral wings.

Genus SEPIOTEUTHIS de Blainville 1824.

Sepioteuthis de Blainville 1824 (*fide* Hoyle).
Sepioteuthis d'Orbigny 1845, p. 319.
Sepioteuthis Wülker 1913, p. 460.

Fins very elongate and marginal, bordering the mantle for nearly or quite its entire length. The outline of the entire animal thus becomes elongate-oval, oval, or elliptical.

Type.—*Sepioteuthis sepiacea* de Blainville 1824 (*fide* Hoyle)=*S. sepioidea* (de Blainville 1823), a species of the West Indian region.

Sepioteuthis arctipinnis Gould 1852.[a] (Pl. LIV, fig. 1.)

Sepioteuthis arctipinnis Gould 1852, p. 479, fig. 93.
Sepioteuthis arctipinnis Tryon 1879, p. 152, pl. 62, fig. 211 (after Gould).
Sepioteuthis arctipinnis Berry 1909, p. 418 (merely listed).
Sepioteuthis arctipinnis Wülker 1913, p. 452, 475, 482.

Adult of moderately large size. Body massive, elongate-conical, compressed dorso-ventrally, tapering to a blunt point behind. Mantle very thick and heavy, its anterior margin free, produced forward to a very obtuse and evenly rounded point in the nuchal region; broadly emarginate below the funnel, the emargination bounded by rather acute prominent angles. Fins enormous; attached along the mantle for almost its entire length; widest at about the posterior third, thence gradually tapering anteriorly but ending rather abruptly just before reaching the mantle margin; posteriorly they narrow very rapidly, being not quite continuous around the hinder tip of the body; each fin at its widest point about three-fourths as wide as the body at the same point; thick at base, but with quite thin margins. Entire outline of body, including fins, a very regular ellipse, anteriorly truncate, smoothly curved behind, and broadest at the posterior third as indicated. Cartilaginous articulations of head and mantle as usual in the genus; large and very prominent.

FIG. 20.—*Sepioteuthis arctipinnis* [42], horny ring of sucker from third arm, camera outline, × 12.

Head squarish, of moderate size. Eyes large and prominent; in front of the orbit a pore; behind it the integument is raised into a conspicuous bilobate angled crest, somewhat excavated in front, and with the "olfactory pore" shel-

[a] The original description of this species is as follows:

"Body elongated, ovate lanceolate, tapering gradually backwards to a blunt point. Fins broadest at about the posterior fourth, where, together, they equal the width of the body, thence tapering in each direction gradually, and without any angle or dilatation. Color dark purple brown above, paler beneath, everywhere finely punctate with dark brown dots. Head narrower than the body, longer than broad. Sessile arms rather short and stout, armed with two rows of cupules; the superior pair shorter than the head; the first lateral pair a third longer than the superior, and somewhat longer than the head; the second lateral pair a little longer than the first; the inferior pair nearly equal to the second lateral; tentacular arms nearly as long as the body, compressed, the distal third having a lanceolate dilatation, bearing four rows of delicately pedunculated cupules, armed at the margin with delicate black crochets. Mouth large, lip folded and projecting, with two or three minute cupules at each fold.

"Length of body, six inches; of head, two inches; of superior arms, two and a half inches; of inferior lateral arms, three inches; of tentacular arms, eight inches; of cup-bearing portion, two and three-fourths inches; greatest width, two and a half inches.

"From the island of Maui, Sandwich Islands.

"It closely resembles *S. loliginiformis*, D'Orb., from the Red Sea, which has a much more decided expansion of the fins at its posterior half, and the tentacular arms are much shorter. The narrow and regularly tapering fin is its distinguishing character. Described from specimens in spirits." (Gould 1852, p. 479.)

tered within the bay of the ventral angle.[a] Funnel very large; broad at the base and tapering bluntly to the wide-valved aperture. Funnel organ enormous, comprising a very large deeply bilobate pad occupying most of the posterior two-thirds of the dorsal wall of the funnel, and a pair of much shorter bean-shaped ventro-lateral pads.

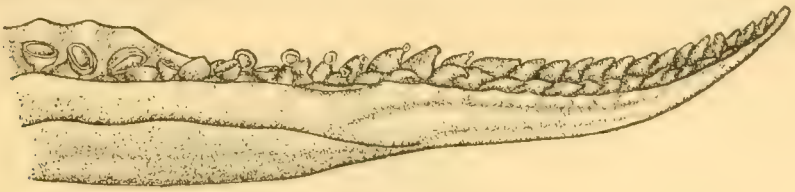

FIG. 21.—*Sepioteuthis arctipinnis* [45], hectocotylized portion of left ventral arm of male, × 3.

Arms of moderate length, stout, squarish, unequal, the order of length 3, 4, 2, 1. All the arms are outwardly keeled and have a broad trabeculated marginal membrane bordering the sucker-bearing area, this membrane reaches its maximum on the central portion of the third arms and is least developed on the ventral pair. Both outer margins of the ventral arms conspicuously keeled, the dorsal keel developed as a broad thickened membrane ensheathing the base of the tentacle. Suckers large, regularly alternating in two rows; the horny rings of the largest armed with 25 to 26 stout acute teeth (fig. 20).

The hectocotylization is as usual in the genus; for about 19 pairs the suckers of both rows are normal; at this point on the left ventral arm the cups become suddenly reduced (although persisting to about the twenty-second pair) and the pedicels correspondingly enlarged; the latter continue as stout conical papillæ to the tip of the arm, those of the dorsal row being considerably larger than their ventral companions (fig. 21).

Tentacles of variable length, laterally compressed; both outer and inner faces subcarinate at the base, the inner becoming flattened and transversely striate distally; on the distal half of the club the outer carina becomes expanded to form a heavy fleshy keel. Club large, expanded; its margins bordered by a crenulate membrane strengthened by rather flattened and illy-defined transverse trabeculæ. Suckers crowded, in four rows; largest at about the middle, especially those of the two central rows, diminishing toward either end; distally all the suckers become very minute, those of the ventral row becoming the largest, of the dorsal smallest; horny ring of a large median sucker armed with 17 to 19 strongly incurved teeth.

FIG. 22.—*Sepioteuthis arctipinnis* [45], dorsal aspect of gladius of male from Honolulu, × ½

Buccal membrane 7-lobed, the lobes pointed and bearing a few very minute suckers near their tips.

Gladius lanceolate; with a heavy midrib and distinct submarginal thickenings (fig. 22).

Color of preserved specimens a brownish buff everywhere beneath the large slate-colored chromatophores. The latter very variable in size; very numerous and much run together dorsally, fewer and more scattered on the ventral aspect; absent from the ventral surfaces of the fins.

[a] My previously published account of this structure in *S. lessoniana* (1912b, p. 402) is ambiguous and very misleading respecting the position of the olfactory pore. The pore is not really dorsal in position, but sheltered within the ventral lobe of the crest as stated above.

MEASUREMENTS OF SEPIOTEUTHIS ARCTIPINNIS.

Number in author's register	45	42	Number in author's register	45	42
Sex	♂	♀	Sex	♂	♀
	mm.	*mm.*	Length of—	*mm.*	*mm.*
Length of mantle (dorsal)	187	163	Third arm	87	81
Width of mantle anteriorly	54	55	Ventral arm	73	77
Width across fins at widest point	120	90	Hectocotylized portion	23	.....
Width of fin at widest point (ventral)	38	25	Tentacle	.....	184
Width of head	41	38	Tentacle club	.....	60
Length of—			Diameter of largest suckers on tentacle	3	4
Dorsal arm	58	48	Diameter of largest suckers on third arms	3	3
Second arm	71	72			

Type locality.—Island of Maui (Gould).

Distribution.—Honolulu, Oahu (*Albatross*, Jenkins, et al.); Maui (Gould); Bertrand Id., north coast of Papua ? (Wülker).

SPECIMENS OF SEPIOTEUTHIS ARCTIPINNIS EXAMINED.

No. of specimens.	Locality.	Collector.	Sex.	Where deposited.	Author's register.
1	Honolulu, Oahu	Jordan & Evermann	♂	Stanford Univ. Coll., Cat. 2098	45
1	.....do	Brandt	♀	Stanford Univ. Coll., Cat. 2099	44
1	Honolulu Reef	O. P. Jenkins	Juv.	Stanford Univ. Coll., Cat. 2100	43
1	Honolulu Market	Albatross expedition	♂	U. S. Nat. Mus	42

Remarks.—The large male from Honolulu, which is the subject of the major portion of the preceding paragraphs, shows certain differences from the description of Gould. Its fins are proportionately wider (the two taken together considerably more than equaling the body in width at their widest point), and the ventral arms are longer, considerably exceeding the head in length. These divergencies do not seem important, however, and on the whole the specimens indicate that *S. arctipinnis* is probably to be regarded as a good species, even though not a very strongly differentiated one.

As compared with male specimens of a near ally, *S. lessoniana* Férussac, from Wakanoura, Japan, the following differences are presented: The animal is smaller, the body a little more slender, more regularly tapering, and the posterior extremity somewhat more acute. The fins do not extend quite so far forward, they do not possess so symmetrically curving an outline, and the point of their widest expansion is at the posterior third instead of at near the middle. The "olfactory crest" is less developed and its lobes angled rather than rounded. The minutiæ of the hectocotylized arm are slightly different, although this may be due to the method of preservation. Lastly, the suckers of the sessile arms have a decidely fewer number of teeth on their horny rings; the variance between the horny rings of the tentacular suckers is very slight but in the same direction. The marginal thickenings of the gladius are also worthy of note, but these have already been called to attention by Tryon. On the whole the relationship between the species is exceedingly close, but so far as my material goes the two may be readily separated by means of the characters noted.

This is another important edible form.

Genus LOLIGO Schneider 1784.

Loligo Schneider 1784, p. 110.
Loligo Lamarck 1798 (*fide* Hoyle); 1799, p. 11 (*fide* Jatta).
Loligo Verrill 1881, p. 307.

Body elongate, tapering posteriorly. Fins terminal; rhomboidal in the young, in the adult more or less sagittate.

Type.—*Sepia Loligo* Linné 1758. As in the case of *Polypus*, Schneider mentions no type or other species, but the clear inference is that *Sepia loligo* Linné was what he had in mind, a conclusion supported by the fact that this was the only species of true *Loligo* which was at that time possessed of a binomial name. Because of the great uncertainty attaching to Linné's species, Hoyle considers *L. vulgaris* Lamarck 1798 to be the type of Schneider's genus as it is that of Lamarck.

[Loligo gahi d'Orbigny 1835.]

Loligo gahi d'Orbigny 1835, p. 60, pl. 3, fig. 1–2.
Loligo Gahi Tryon 1879, p. 144.

Tryon gives us an alleged record of this species from the Hawaiian Islands in the following words: "Specimens in Mus. Phila. Acad., said to come from the Sandwich Islands, agree well in the dentition of the rings with this species." As this is a characteristic Peruvian and Chilean species there is no doubt that the citation is an error.

Strangely enough the above is the only record I have been able to find of the presence of any member of the cosmopolitan genus *Loligo* in Hawaiian waters, and I am unable even with the aid of the large collection now in hand to affirm its occurrence there.

Family SEPIOLIDÆ Keferstein 1866.

Sepiolini Steenstrup 1861 (*fide* Hoyle).
Sepiolidæ Keferstein 1866, p. 1443.
Sepiolidæ Verrill 1881, p. 347, 416.
Sepiolidæ Joubin 1902, p. 80, etc.
Sepiolidæ Pfeffer 1908, p. 24, 31.
Sepiolidæ Naef 1912, p. 243, 244.

Body short, thick, rounded posteriorly. Fins large, separate, ovate or rounded, attached laterally near the middle of the body. Eyes with a thickened ventral fold or false lid, and sometimes a dorsal fold as well. Median septum of mantle cavity reenforced by a pallial retractor muscle joining the mantle to the body. Internal shell a very rudimentary uncalcified gladius, often entirely absent. Eggs large and few. A photogenic gland is often present in the pallial cavity overlying the ink sac; from it a luminescent secretion is emitted.

Subfamily SEPIOLINÆ Naef 1912.

Sepiolini Appellöf 1898, p. 623.
Sepiolinæ Naef 1912, p. 246, 247.

Mantle margin united with head in nuchal region by a band-like commissure. Left dorsal arm hectocotylized. Photogenic glands often absent; when present of elongate form, well separated, and more or less lateral in position.

Genus EUPRYMNA Steenstrup 1887.

Euprymna Steenstrup 1887, p. 66.
Euprymna Steenstrup 1887a, p. 88–90 (42–44).
Euprymna Hoyle 1904, p. 24.
Euprymna Wülker 1910, p. 9, 26, etc.
Euprymna Naef 1912, p. 247.

Suckers of sessile arms in four rows, except at tip and extreme base; on tentacle club long stalked, very minute, urceolate, and in very numerous (more than 16) rows. Nuchal commissure over one-third as broad as the body. Left dorsal arm of male hectocotylized, the distal suckers closely palisaded together and of very characteristic structure; the remaining arms differ from those of the female in the possession of certain peculiarly enlarged suckers. Large elongate photogenic glands present. Gladius wanting.

Type.—*Inioteuthis Morsei* Verrill 1881 (species first mentioned), a common Japanese species.

Euprymna scolopes Berry 1913. (Pl. XLIX, fig. 5–8, text fig. 23–26.)

Euprymna morsei Berry 1909, p. 418 (locality record only), *not* of Verrill.
Euprymna scolopes Berry 1913, p. 564.

Animal small, sepioliform. Body short, thick, rounded; the transverse diameter usually equal to about two-thirds to four-fifths of the length, but the entire outline and proportions very variable. Fins large, semicircular; attached with a considerable degree of obliquity a little in advance of the middle of the body; broadest posteriorly; anterior lobe conspicuous and abruptly notched at its inward margin, so that the fin is actually attached along only about the posterior two-thirds of its length. Mantle united with the head in the nuchal region by a broad commissure, so that the pallial aperture extends but a very small distance past the eyeball, which it partially encompasses posteriorly. Ventrally the mantle margin is sinuous and somewhat produced forward on either side of the funnel, though with a more or less conspicuous emargination just beneath the latter.

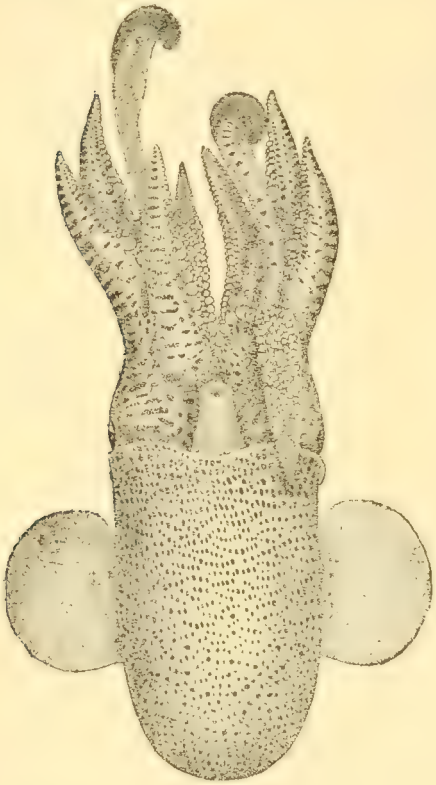

FIG. 23.—*Euprymna scolopes*, ventral view of male [320] type, × 1½. Drawn by R. L. Hudson.

Head somewhat broader than long, its transverse diameter usually a little less than that of the mantle, but sometimes slightly exceeding it; broadly flattened above, somewhat hollowed out below for the accommodation of the funnel. Eyes somewhat swollen, large and prominent. Funnel elongate conical; the extremity nearly cylindrical, with thick walls, and a small apical aperture; tip nearly or quite attaining the base of the ventral arms; interior walls of tip minutely striate longitudinally; the minute spoon-shaped valve is situated on the dorsal wall just back of the striated area and is succeeded posteriorly by a region of strong transverse striation. Funnel organ posterior in position and very similar to that of *E. morsei* (see Berry 1912b, p. 409).

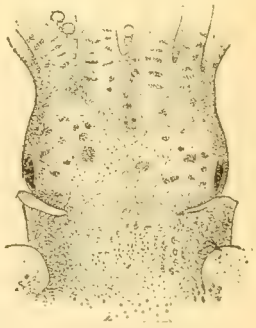

FIG. 24.—*Euprymna scolopes*, dorsal view of head of male [320], × 1½ Drawn by R. L. Hudson.

Arms rather short, stout; usually as long as or a little longer than the mantle; unequal, the brachial formula consistently 2, 3, 4, 1, although the dorsal arms are only a little shorter than the ventral; outer surfaces of ventral arms rounded, the others all furnished with a delicate colorless carina or fold of membrane, best developed on the third arms, but sometimes obscure even there. Umbrella rudimentary or lacking (in some specimens) between the dorsal arms as well as those of the ventral pair; better developed between the dorsal and second arms and between these and the third pair; between each third arm and its ventral companion it forms the usual broad sheath inclosing the base of the tentacle. Suckers on all the arms in two rows at the extreme base, but the succeeding pairs soon undergo an alternate lateral displacement, resulting in a four-rowed condition, which prevails practically to the extremities of the arms; pedicels stout, conical; cups spherical, with small apertures, and easily lost through abrasion; horny rings of larger suckers (at least in the female) smooth.

In the female the suckers of the various arms are relatively minute and of subequal size at homologus regions of the arms, but in the male a number of important modifications occur. In specimens of the latter sex the left dorsal arm is conspicuously hectocotylized; the first four pairs of suckers at the base

are in two rows; at the point where the 4-rowed condition commences the ventral series contains two (sometimes apparently only one) modified papillæ, usually differentiated from the ordinary sucker pedicels, with which they are undoubtedly homologus, by their more slender shape and oblique position. Distal to this point occur about 10 quartets of small globular suckers similar to those of the female, except that those of the dorsal row are a little the largest. Beyond its basal third the arm becomes much swollen, while the suckers of the two ventral rows suddenly give place to a compactly crowded, rather irregular series of massive transversely elongate and compressed papillæ, bearing a mouth-like aperture in place of a true sucker at their inner apex, and continuing in constantly diminishing size to the tip. The suckers of the two dorsal rows continue normally for two or three pairs farther than the ventral, when they too undergo modification, appearing as a crowded alternating double series of swollen tubercles, their pedicels not transversely compressed nor so closely palisaded as those of the ventral papillæ. As in the case of the latter, the suckers themselves are reduced to mere lip-like slits at the apices. In all cases these apertures appear to be guarded by a highly modified very minutely toothed horny ring. Except in minute details, the whole structure is thus seen to offer a close parallel to that which has been described for *E. morsei*.

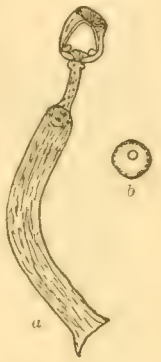

FIG. 25.—*Euprymna scolopes*: *a*, sucker from tentacle club [323], from a mount in balsam, greatly enlarged; *b*, oral aspect of horny ring from same, same scale.

The right dorsal arm is more slender than the left and approaches more closely than any of the other arms to the condition observed in the female; all the suckers crowded, minute, but those of the median rows rather the more so; the suckers of the ventral row in their turn slightly smaller than those of the dorsal series. On the arms of the second pair the suckers of the outer rows are larger than those of the inner; about six of the basal suckers of the dorsal row are notably larger than the remaining members of the series; in the ventral row about eight suckers along the distal two-thirds of the arm are greatly enlarged (though not to such an extent as in *E. morsei*) and occur in alternation with other suckers of the same row having scarcely a third the diameter. The third arms likewise have their marginal suckers larger than the inner, 8 to 10 alternating suckers of the ventral row being much enlarged. The same condition prevails on the ventral arms and is only a little less conspicuous; here three or four suckers of the dorsal series are similarly affected, though in less degree.

Tentacles very variable in length, elastic, compressed; keeled near the extremity, inner surface flattened. Club little expanded; closely recurved and coiled upon itself at the tip; inner aspect villous in appearance, due to the exceeding minuteness of the numerous suckers. Individual suckers deeply urceolate, slightly oblique, the so-called papillary area very wide, so that the inner aperture is much reduced; pedicels very long, their basal portions columnar and closely packed together, so that the suckers are mobile only by virtue of a much shorter constricted peduncle, which serves to join the cupules to the main stalk.

FIG. 26.—*Euprymna scolopes* [323], diagrammatic representation of papillary area of tentacular sucker, greatly enlarged.

Buccal membrane seven-pointed; thickened, with rugose edges.

Gladius, none.

Color of preserved specimens a pale brownish buff, sometimes spotted above with conspicuous well-defined dark dots, sometimes heavily clouded (especially over the dorsal surface) with dark bluish slate, depending upon the state of expansion or contraction of the chromatophores. There is an especially conspicuous series of large transversely elongate chromatophores ranked in close succession along the outer aspect of each of the sessile arms, and a very similar series of smaller chromatophores extends along the distal portion of the tentacle stalk. The following note as to the color of this species during life appears in Dr. Fisher's handwriting on the reverse of one of the original labels: "Sepia: Chromatophores brown yellow and sepia eyeballs and visceral sac tinged with iridescent Nile green and blue."

Larval or young specimens differ most conspicuously from the adult in their shorter more inflated mantle, larger head, and the fewer and more definite chromatophores. The secondary sexual characters begin to become conspicuous at least as early as the stage with an average mantle length of about 10 mm.

MEASUREMENTS OF EUPRYMNA SCOLOPES.

Number in author's register	187	319	321	312	320	323	323	308
Sex	♀	♀	♀	♀	♂ (type)	♂	♂	♂
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Total length	128	54	50	20	63	74	52	44
Tip of body to base of dorsal arms	41	35	32	13	35	36	31	18
Tip of body to tip of second arms	71	54	47	20	59	61	49	32
Tip of body to mantle margin	28	25	23	9	25	24	21	12
Width of mantle	21	20	18	9	16	18	14	11
Length of fins, total	10	13	12	5	12	13	10.5	7
Length of fins along plane of attachment	8	9	8	3	8	9	6.5	4.5
Width across fins	38	35	33	14	29	36	26	19
Width of dorsal commissure	9.5	10	10.5	5.5	10	12	10.5	7
Length of head	13	11	11	4	10	13	10	6
Width of head	18	17	16	8	15	18	15	11
Length of—								
Right dorsal arm	28	16	15	7	20	20	16	11
Left dorsal arm	27	16	14	5.5	20	20	16	8.5
Second arm	38	23	20	9	27	27	21	15
Third arm	34	21	19	8	23	23	20	13
Ventral arm	31	18	15	7	20	21	18	11.5
Tentacle	92	22	22	8	31	43	24	28
Tentacle club	16	6	7	.....	5.5	6	5	4
Funnel	16	11.5	. .	.	..	. .	12	.

Total length of smallest specimen examined 8 mm.; of mantle of same 3 mm.

Type.—Catalogue No. 214380, United States National Museum [S. S. B. 320].

Type locality.—*Albatross* station 3905, surface, off Kalaupapa, Molokai, April 30, 1902; 13 specimens.

Distribution.—Known only from the region of the Hawaiian Islands (*Albatross*, Jenkins, Berndt).

Material examined.—The 64 specimens of this species which have been examined are to be catalogued as follows:

Number of specimens.	Locality.	Depth in fathoms.	Collector.	Sex.	Where deposited.	Author's register.
1	Off Lae-o Ka Laau Light, Molokai.	Surface.	Albatross station 3821	♂		309
1	Off Avalu Point, Lanai	Surface.	Albatross station 3829	♀		311
1	Off Lae-o Ka Laau Light, Molokai.	60–64	Albatross station 3846	♀		318
1	Pailolo Channel	127	Albatross station 3856	♀		319
1	do	127–128	Albatross station 3857	♀		315
1	do	138–140	Albatross station 3859	♂		305
1	Off Mokapu Islet, Molokai	Surface.	Albatross station 3889	♀		312
2	do	Surface.	do	juv.		307
1	Auau Channel	126–130	Albatross station 3896	♂		322
1	Off Kalaupapa, Molokai	Surface.	Albatross station 3905	♂	U. S. Nat. Mus., Cat. 214380; type.	320
12	do	Surface.	do	♂ ♀	Paratypes	323
1	21° 13′ N. lat., 158° 43′ W. long.	Surface.	Albatross station 3926	♀		304
2	25° 27′ N. lat., 171° 08′ W. long.	Surface.	Albatross station 3931	juv.		302
6	Between Oahu and Kauai	Surface.	Albatross station 3980	juv.		317
3	do	Surface.	do	juv.		300
5	do	Surface.	Albatross station 4010	juv.		310
1	Off Puniawa Point, Maui	52–56	Albatross station 4071	♀		306
1	do	69–78	Albatross station 4073	♂		303
1	Pailolo Channel	122–132	Albatross station 4102	♂		308
2	do	122–132	do	♀		313
1	do	132–141	Albatross station 4103	♂		301
1	Vicinity of Modu Manu	Surface.	Albatross station 4152	juv.		314
1	do	Surface.	Albatross station 4153	juv.		316
1	Honolulu Reef, Oahu	Shore.	Albatross expedition	♀		187
1	do	Shore.	do	♀		321
9	do	Shore.	O. P. Jenkins	4 ♂ 5 ♀	Stanford Univ. Coll., Cat. 2094.	299
1	Honolulu Market		Louis Berndt	♂	Stanford Univ. Coll., Cat. 2095.	298
1	Honolulu, Oahu	Shore	do	♂	Stanford Univ. Coll., Cat. 2096.	297
1	do	Shore.	do	1 ♂ 2 ♀	Stanford Univ. Coll., Cat. 2097.	296

Remarks.—The specimens which have been made the subject of the foregoing detailed description do not appear to offer any features in essential disagreement with Grant's brief account of his *Sepiola stenodactyla* from Mauritius, but with the recent more careful description by Hoyle[a] of some south Pacific specimens which he referred to Grant's species they are not in complete accord. The observed differences are admittedly trivial, but they maintain themselves persistently and with great constancy throughout the large series of specimens which has been examined and hence seem worthy of recognition. As in the case of most closely related sepiolids the chief difference is in the structure of the hectocotylized arm. In Hoyle's figure of *S. stenodactyla* the modified papillæ begin about halfway up the arm. Those of the ventral row are comparatively stout, fairly regular, not very closely appressed, and the figure shows only about fifteen of them. The conspicuous thickening of the arm at the point where the papillæ begin and the strongly recoiled tip exhibited by the Hawaiian specimens do not appear. In *E. scolopes*, moreover, the modified papillæ extend over a much greater proportional area (two-thirds) of the arm, are much more numerous (35 to 40 in the ventral row), and so tightly palisaded together that many of them are squeezed quite out of place. The details regarding the modified suckers of the remaining arms are also different from Hoyle's description, especially in the case of the third pair, where in *E. scolopes* about twice as many of the suckers in the ventral series undergo enlargement. Unfortunately this comparison has been hampered by the lack of actual specimens of *E. stenodactyla* or any other Indo-Malayan representatives of the genus, so that the separate recognition of the Hawaiian race should perhaps be regarded as somewhat provisional.

It is interesting to note that the differences separating the Japanese *E. morsei* from either *stenodactyla* or *scolopes* are not very conspicuously greater than those just dwelt upon, but they appear equally constant, and I regard my original reference of the Hawaiian material to *E. morsei* as clearly erroneous. The males of the last-named species may be distinguished at a glance by the much more conspicuously enlarged suckers of the outer rows on the sessile arms, especially those of the second pair. Apart from secondary sexual characters, however, a description of one species, however detailed, would, so far as I am aware, serve almost equally well for either of the others, and I am at a loss to name any satisfactory criterion for the separation of any of these puzzling forms when represented by females alone.

E. scolopes is one of the most abundant and ubiquitous cephalopods of the Hawaiian Islands. Not only is it a common surface form throughout the surrounding waters but it is to be captured on the reefs and even at considerable depths, as may be seen from the accompanying table. It is, however, a surprisingly constant species, the greatest variation observed being in the general form and proportions of the body, and even this is more probably due to the varying stresses of preservation than to any inherent differences in the animals themselves. It doubtless possesses luminous properties as glandular organs similar to those described by Meyer (1906) for *Sepiola*, and more especially by Wülker (1910, p. 26) for *E. morsei* are very conspicuous in a corresponding position within the mantle cavity.

The specific name *scolopes* has been adopted in reference to the stockade-like appearance of the outer papillæ on the hectocotylized arm.

Subfamily STOLOTEUTHINÆ, new subfamily.

Mantle and head united in the nuchal region by a commissure. Suckers in two rows, for the most part very small. Both dorsal arms hectocotylized, but the modification weak, consisting chiefly in the greater or smaller size and more crowded condition of the suckers. Eyes with a completely circular lidlike fold. Gladius, none.

Genus STOLOTEUTHIS Verrill 1881.

Stoloteuthis Verrill 1881, p. 417.
Stoloteuthis Verrill 1882, p. 375 [165]

Body short and thick, bluntly rounded behind. Fins large. Arms short; all except the ventral pair united by a wide delicate basal web. Suckers for the most part minute. Mantle ornamented ventrally by a sharply delimited and specially pigmented shield-shaped area of the integument.

Type.—*Sepiola leucoptera* Verrill 1878 (monotypic); a species of the New England region.

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[a] Hoyle, 1904, p. 24, fig. B-D.

Subgenus IRIDOTEUTHIS Naef 1912.

Iridotheuthis Naef 1912, p. 247.

Body extremely short and rounded; transversely compressed. Nuchal commissure very broad, reaching to a point opposite the anterior margin of the fins. Fins exceedingly large, their basal attachment relatively narrow. Mantle produced far forward ventrally so as to nearly conceal the head and funnel. Head very large, the eyes much swollen and protruding. Arms very unequal; dorsal and second pairs short; third pair considerably longer. Photogenic organs inconspicuous, leaving the greater portion of the ink sac uncovered.

Type.—*Stoloteuthis iris* Berry 1909 (monotypic); described from the Hawaiian Islands.

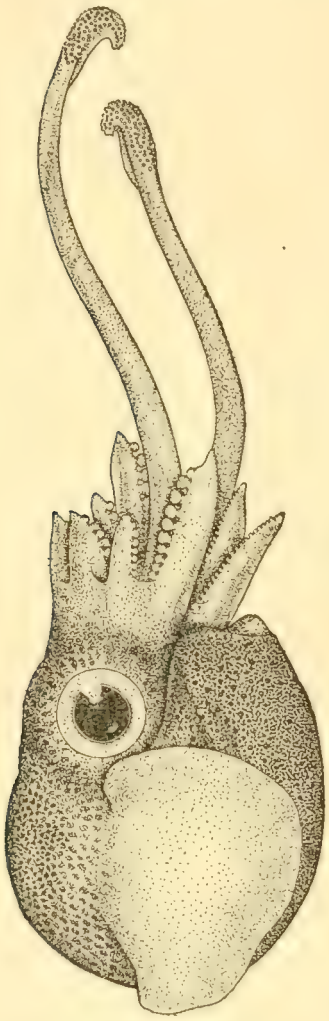

FIG. 27.—*Stoloteuthis iris*, lateral view of type [31]. × 4. Drawn by R. L. Hudson.

Stoloteuthis (Iridoteuthis) iris Berry 1909. (Pl. L, fig. 1, 2.)

Stoloteuthis iris Berry 1909, p. 410, 418, fig 3.
Iridotheuthis iris Naef 1912, p. 247.

Body small, short, stout; much compressed and flattened laterally, rounded very abruptly behind; width and length dorsally about equal and both greatly exceeded by the depth. Mantle smooth, broadly continuous above with the integument of the head from which it is delimited only by a rather prominent cutaneous line or shallow fold; anterior ventral margin produced forward beneath the eyes and far past them to form a broad, deeply convex lobe, which almost entirely conceals the funnel and ventral surface of the head to which its upturned anterior margin is closely applied. A shallow notchlike indentation in the free anterior edge of the lobe permits the tip of the funnel to be seen; convex central region of lobe differentiated from the rest of the mantle surface as a large, slightly raised and flattened, heart-shaped area. Laterally, as in Verrill's *Nectoteuthis*, the mantle margin "recedes in such a way as to leave the large prominent eyes exposed." Fins relatively enormous, thin, their outline rounded oblong to subcircular; much narrowed at the base; slightly broader and conspicuously longer than the body, exceeding it both anteriorly and posteriorly; anterior margin reaching to the eyes, its extremity rounded; posterior margin obtusely pointed; the plane along which the fins are attached is considerably above the median horizontal plane of the body.

Head extremely large; short, wide, flattened. Eyes large, so swollen and protruded in the only specimen at hand that they have lost all appearance of having free lids, perhaps because in pushing outward they have evaginated the usual circular lid fold; they are situated in the angle of the mantle margin above the ventral lobe. Funnel visible only after the removal of the mantle lobe; very broad at base, thence rapidly tapering to a sudden and deep constriction which occurs just in advance of the middle; entire extremity beyond the constriction swollen and thickened; a secondary gland-like swelling occurs on the dorsal external aspect of the funnel in this region, terminating in a very short blunt papilla which fits in between the true tip of the funnel and the bases of the ventral arms; walls of funnel thick, the interior narrowed and of relatively small capacity; aperture very minute. Funnel organ large, occupying almost the entire interior surface posterior to the median constriction; dorsal cushion with widely flaring lateral wings, almost trilobate in outline; vèntro-lateral pads large, wide, and very loosely

adherent. Locking apparatus a slightly curved cartilaginous groove at either side of the base of the funnel with conspicuous ridges to correspond on the inner wall of the mantle considerably posterior to its margin.

Sessile arms short, connected by a well-developed basal web reaching beyond the middle of the dorsal arms, but diminishing ventrally and entirely absent between the ventral pair; conspicuously unequal, the order of length 3, 4, 2, 1; third pair much the stoutest and longest and with somewhat larger suckers than the remainder, also differing in the possession of a prominent membranous keel bordering their outer margins; ventral arms also keeled in somewhat similar fashion, but less prominently. Suckers in two rows on all the arms, crowded; extremely minute, especially on the dorsal and ventral arms; those of the second arms slightly larger, and those on the third pair distinctly the largest of all, although not very conspicuously so (most of the suckers on this pair of arms have been lost through abrasion, so that it can not be determined whether or not any of the more distal ones are subject to enlargement or other special modification; the stumps of the pedicels, however, are entirely similar to one another); individual suckers spherical, with small openings and smooth horny rings; pedicels very short.

Tentacles exceedingly long and slender; tapering; slightly thickened at the base; club but little if any wider than the stalk, velvety in appearance, and under a high power lens seen to be armed with about eight rows (fewer at base) of extremely minute crowded suckers, those near the base somewhat the largest, thence gradually and regularly diminishing in size toward the tip. (Pl. L, fig. 2.)

Ink sac large, by no means covered by the photogenic glands, which, though distinct in the present material, appear to be of small size and very anterior position.

Gladius not observed; probably absent as in *S. leucoptera*.

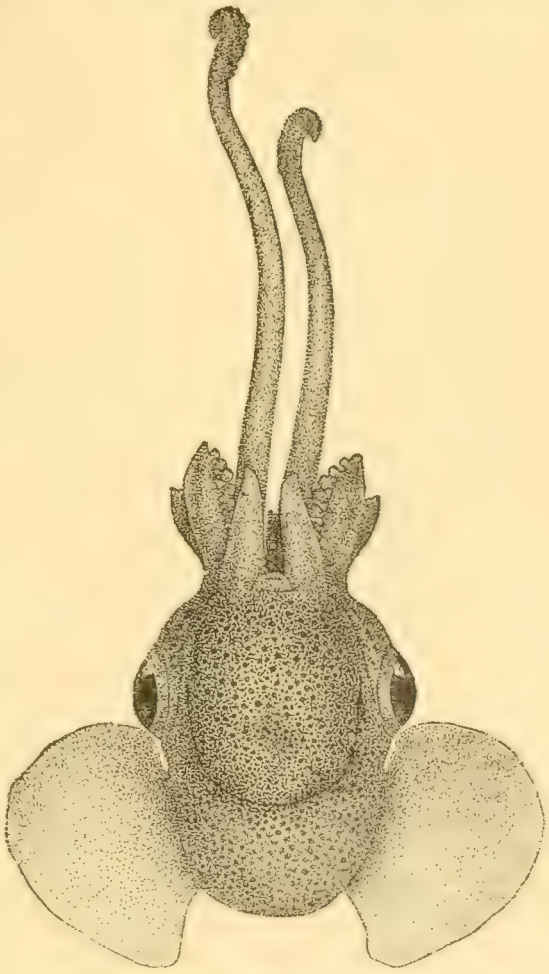

FIG. 28.—*Stoloteuthis iris*, ventral view of type [31], × 4. Drawn by R. L. Hudson

Color in alcohol for the most part a brownish white; suffused about the eyes, base of the fins, and notably about the ventral shield, with a purplish black; fins unmarked; mantle closely speckled above and below with small brownish chromatophores of two main types, which become rather fewer in number posteriorly and on the sides; those of the one type are paler, larger, more suffused, and more evenly distributed; the others are darker, much smaller, more distinct, and more exclusively confined to certain areas, such as the dorsum and especially the ventral shield, where they are very thickly and evenly distributed; the difference is very apparent, but I am not sure what morphological

significance, if any, is possessed by it. The ventral surface is further ornamented by a dark bluish-gray band bordering the heart-shaped shield.

The following note appears on the reverse of the original station label in the handwriting of Dr. W. K. Fisher and affords important information regarding the appearance of this species in life (colors according to Ridgway's "Nomenclature of Color"): "Tentacles, chromatophores burnt sienna, yellow ocher, and light red. Eye: pupil transparent, iridescent purple, blue, and emerald green; iris reddish burnt sienna. Body (except wings and outer test) iridescent orange, yellow, solferino, green, crimson, purple. Chromatophores of outer test burnt sienna and sepia."

MEASUREMENTS OF STOLOTEUTHIS (IRIDOTEUTHIS) IRIS.

	mm.		*mm.*
Total length exclusive of tentacles	16	Length of head	4
Medio-dorsal length of mantle	7	Width of head	8
Medio-ventral length of mantle	11	Length of—	
Width of body	7	Dorsal arm	4
Width across fins	18	Second arm	5
Extreme length of fin	9	Third arm	6
Length of same fin at base of attachment	4	Ventral arm	5
Median length of ventral shield	7	Right tentacle (left tentacle missing)	21
Dorsal-ventral diameter of body	10		

Type.—Catalogue No. 214312, United States National Museum [S. S. B. 31].

Type locality.—The type and only specimen of the species known was taken in 153 to 142 fathoms, *Albatross* station 3832, off the island of Molokai, bottom of brown mud and sand.

Remarks.—The sex of the single specimen is unknown, as owing to the brittle texture of its tissues it was deemed inadvisable to attempt to pry the arms far enough apart to ascertain any further details of structure or possible evidences of hectocotylization. It is very possible that the specimen is not quite adult, but its characteristic features have nevertheless attained a high development.

Perhaps the most distinctive features are the extreme development of the dorsal commissure uniting the mantle to the head, and the immense ventral lobe. The former feature is carried to a much further extreme in this species than in either *S. leucoptera* or in *S. nipponensis*, which are the only other described species of the genus, while in the latter respect the only near approach is the *Nectoteuthis pourtelesii* of Verrill. According to information furnished me by Dr. Ad. Naef, *S. nipponensis* differs from the other species mentioned in important anatomical characters, as well as in its size and general aspect, and must henceforth be known as *Sepiolina* Naef. Its exact systematic position still seems a matter of more or less uncertainty, although Naef refers it to the *Sepiolinæ*. All three of the remaining species, *S. leucoptera*, *S. iris*, and *N. pourtelesii*, are characterized by the possession of a conspicuous pigmented shield on the ventral surface similar to that above described, have large fins, and are delicate gaily colored creatures of doubtless similar habits. *N. pourtelesii*, however, stands quite alone in having the dorsal border of the mantle entirely free, and *S. iris* likewise is in many ways very different from its congener. Because of this fact it also has recently been made by Naef the type of a separate genus, *Iridoteuthis*, but because its most important characters (nuchal commissure, ventral shield, webbed arms, etc.) are shared equally with *Stoloteuthis* s. s., I believe their probable relationships are for the present expressed better by grouping them together. The distinctive features adduced by Naef are the integumentary fold in the nuchal region, the large head, protruding eyes, immense fins, ventral protraction of the mantle, and unequal arms, but none of these features seem sufficient of themselves to be regarded as of more than subgeneric value. A more complete knowledge of either *S. iris* or *S. leucoptera* than we at present possess might, however, indicate differently.

Subfamily HETEROTEUTHINÆ Appellöf 1898.

Heteroteuthinæ Appellöf 1898, p. 624.
Heteroteuthinæ Joubin 1902, p. 111.
Heteroteuthinæ Naef 1912, p. 246.

Mantle margin free all around; a cartilaginous articulation in the nuchal region, but the mantle and body fused farther back. Right dorsal arm hectocotylized. Photogenic glands large and conspicuous, nearly covering the ventral surface of the ink sac; closely conjoined along the median line.

Genus HETEROTEUTHIS (Gray 1849).

Rossia (*Heteroteuthis*) Gray 1849, p. 90.
Heteroteuthis Steenstrup 1900, p. 287.
Stephanoteuthis Berry 1909, p. 408.
Heteroteuthis Naef 1912, p. 246.

Body plump, compact; obtusely pointed posteriorly. Fins large, more posterior than anterior in position. Ventral mantle margin produced forward beneath the head so as to almost or even entirely conceal the funnel. Arms short, webbed all around except between the ventral pair. Right dorsal arm hectocotylized and united at base with the second arm of the same side; a few suckers on the third arms of the male greatly enlarged.

Type.—*Sepiola dispar* Rüppell 1844 (monotypic); a species of the Mediterranean region.

Heteroteuthis hawaiiensis (Berry 1909) Naef 1912. (Pl. L, fig. 3–8.)

Stephanoteuthis hawaiiensis Berry 1909, p. 409, fig. 2; p. 418.
Semirossia (?) sp. Berry 1909 p. 418 (merely listed).
Heteroteuthis hawaiiensis Naef 1912, p. 246.
Heteroteuthis hawaiiensis Berry 1912c, p. 645.

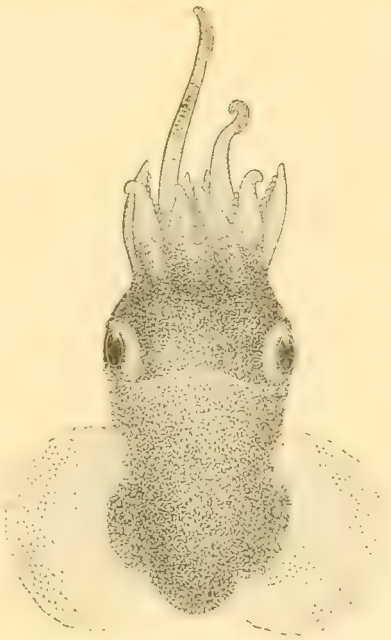

FIG. 29.—*Heteroteuthis hawaiiensis*, dorsal view of type [sc], × 1½. Drawn by R. L. Hudson.

Female (type specimen): Body short, plump, compact, very firm and solid; dorsal aspect tapering posteriorly and terminating past the fins in an obtuse point; ventral half of body more rounded, scarcely tapering, and abruptly surpassed above by the pointed dorsal portion, from which it is separated by a short curved horizontal groove, as though the dorsal and ventral halves of the body were slid upon one another beneath the integument like the two divisions of a large bean; dorsum less convex than the venter, which is full and rounded. Mantle margin free all around, sinuous; slightly projecting above, thence sweeping backward, downward, and then far forward again, broadly curving beneath the eyes to form a conspicuous ventral lobe, which, though slightly emarginate in front, entirely conceals both the funnel and the ventral surface of the head. In the nuchal region a little way behind the margin the mantle is united to the body by an indistinct cartilage and a delicate membrane which is easily torn away. Ventral locking apparatus essentially as in other Sepiolids; an elongated groove with a raised and reflexed margin articulates on either side of the base of the funnel with a thickened ridge on the inner surface of the mantle, the ridge bent at its anterior end so as to inclose a small pitlike depression. The very tight adhesion of the ventral lobe of the mantle to the head is secured in two ways: First, by the strong upward flexion and close application of the margin to the ventral surface of the head, and, secondly, by the insertion of this margin into two deep curved grooves extending obliquely along the under surface of the head from a point about midway of the lower eyelid, nearly but not quite to the cleft between the ventral arms; on the eyelid the groove is shallowest, deepest at its inner end, and bounded anteriorly by a heavy raised margin. (Pl. L, fig. 7 and 8.)

Head very large, due to the large rounded eyes; broader than the body; flattened above, much excavated beneath. Eyes prominent, with large white pupils and a very deep ventral lid fold. Funnel very stout and thick; flattened; outline bluntly conical; extremity rounded; aperture small.

Sessile arms short, stout, thick; unequal, the order of length 3, 4, 2, 1; dorsal pair shortest, third pair longest,[a] but the ventral almost as long as the third and even longer if measured along the cleft separating their inner ventral margins; connected at base by a fleshy umbrella, best developed between the dorsal arms, between these and the second pair, and between the third pair and the ventral pair; between the second and third arms the web is very short, and is totally lacking between the arms of the ventral pair, which are divided from one another by a deep cleft extending as far back as the tip of the funnel; second arms rounded, the remainder with a distinct keel along their outer margins distal to the webbed portion. Suckers small, spherical, oblique; in two rows extending nearly or quite to the tips of the third arms, but leaving the final distal extremities of all the other arms bare; this circumstance becomes especially conspicuous in the case of the second pair, where the distal portion of the arm is not only devoid of suckers, but is minutely ridged transversely and exhibits a strong tendency to recoil upon itself (pl. L, fig. 5); horny rings of suckers smooth.

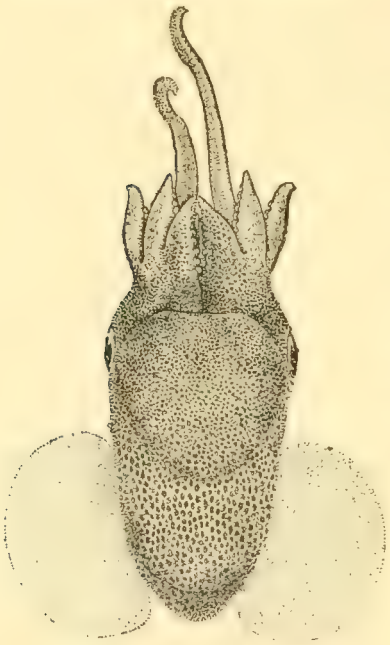

FIG. 30.—*Heteroteuthis hawaiiensis*, ventral view of type [30], × 1½. Drawn by R. L. Hudson.

Tentacles rather short, stout, angled, slightly tapering, with a flattened and somewhat grooved out inner surface. Club small, of considerably less diameter than the stalk; inner aspect with a velvety appearance, due to the great multitude of exceedingly minute suckers with which it is armed (pl. L, fig. 3).

Surface everywhere smooth.

Color of the living animal unknown; in alcohol a brownish buff; fins and arm tips unmarked; dorsum and head heavily dotted and clouded with the blackish chromatophores which appear as open reticulations about the bases of the fins; ventral surface of mantle less densely pigmented, except for a shield-shaped area occupying the ventral lobe and extending back therefrom, over which the chromatophores are very numerous and distinct, being apparently of two main sizes, somewhat as noted in the case of *Stoloteuthis iris;* the marginal delimitation of this area is by no means so distinct and conspicuous as the corresponding region of *Stoloteuthis* and was hence overlooked by the artist when the first drawings were made (pl. L, fig. 7). Chromatophores appear also upon the ventral aspect of the head and funnel, even extending upon the dorsal surface of the latter, but are not to be distinguished upon the tentacles.

Gladius apparently wanting.

MEASUREMENTS OF HETEROTEUTHIS HAWAIIENSIS.

	mm.		*mm.*
Total length, exclusive of tentacles	38	Width between eyes	10
Medio-dorsal length of mantle	22	Length of—	
Medio-ventral length of mantle	27	Dorsal arms	8
Width of body	14	Second arms	9
Width across fins	32.5	Third arms	10
Extreme length of fins	17	Ventral arms	9–12
Length of fins at base of attachment	9.5	Tentacle	21
Anterior mantle margin to base of dorsal arms	8.5		

[a] Owing to an inadvertence the original description states the reverse to be true.

In addition to the specimen above described, the *Albatross* collection contains three other individuals which are so badly macerated (as though taken from the digestive cavities of larger animals, as was undoubtedly the case) that their true identity was not ascertained for a considerable length of time. One of these is a male and has been made the subject of the following notes:

Male: Third arm pair very much larger than the others, bearing two or more very greatly enlarged basin-shaped suckers (pl. L, fig. 4) at their distal ends. No evidence of hectocotylization visible except that the left dorsal arm is much smaller than the right and is closely united with its neighbor of the second pair by a very narrow basal webbing; no true fusion of the arms on either side can be made out after the fashion described for *H. dispar*.

The firm adherence of the mantle and body just back of the nuchal cartilage is very clearly evident in this specimen.

The extremely desiccated condition of the specimen precludes the giving of more accurate or complete details.

Type.—Catalogue No. 214311, United States National Museum [S. S. B. 30].

Type locality.—*Albatross* station 3989, 733 to 385 fathoms depth, in the vicinity of the island of Kauai, coral sand and rock bottom, June 11, 1902; 1 ♀.

Distribution.—Vicinity of the Hawaiian Islands (*Albatross*).

SPECIMENS OF HETEROTEUTHIS HAWAIIENSIS EXAMINED.

No. of specimens.	Locality.	Depth in fathoms.	Collector.	Sex.	Remarks.	Author's register.
1	Vicinity of Kauai	385–733	Albatross station 3989	♀	U. S. Nat. Mus.; type, Cat. 214311.	30
1	Pailolo Channel	280–283	Albatross station 3900	♀	Fragmentary	34
1	do	297–306	Albatross station 4088	♂	do	33
1	do	297–304	Albatross station 4089	?	do	333

Remarks.—The only other species of this genus which are at present recognized are the *H. dispar* (Rüppell) of the Mediterranean region and *H. weberi* Joubin from the Dutch East Indies, from each of which *H. hawaiiensis* appears clearly distinct. Its nearer relationships are certainly with *H. dispar*, but it is to be differentiated on the following grounds:

1. Indications of the presence of a ventral shield similar to that already familiar in *Nectoteuthis* and *Stoloteuthis*, but much less clearly defined.
2. The complete concealment of the funnel by the ventral lobe of the mantle.
3. The heavy oblique folds on the under surface of the head which apparently function to secure a more perfect application of the mantle margin to the head and thus serve as a secondary locking apparatus.
4. The curious nonconformity between the dorsal and ventral halves of the body in mature females.
5. The shorter arms.

The adults of this species are very neat, compact little creatures of pleasing appearance, and like all their near allies are probably quite brilliantly colored when living. They also possess luminous properties, the photogenic glands overlying the ink sac in the present species being in all respects closely similar to those described for *H. dispar* and very conspicuous even in the macerated specimens.

DIVISION ŒGOPSIDA (d'Orbigny 1845).

Decapoda Oigopsidæ d'Orbigny 1845, p. 367.
Chondrophora Gray (pars) 1849, p. 36, 37.
Œgopsidæ Keferstein 1866, p. 1444.
Oigopsidæ Verrill 1881, p. 427.
Œgopsida Hoyle 1886, p. 32, 162.
Œgopsidæ Pfeffer 1900, p. 151.
Œgopsida Chun 1910, p. 3.
Œgopsida Pfeffer 1912, p. 1.

Eyelids perforate over the cornea; their margins free all around and continuous except for the usual presence of a notch or sinus in front. Suckers on either the sessile arms or tentacles or both frequently

transformed into hooks. Complex photogenic organs of polymorphic structure and undoubtedly polyphyletic origin are of repeated occurrence.

Family ONYCHOTEUTHIDÆ Gray 1849.

Onychoteuthidæ Gray 1849, p. 36, 45.
Onychoteuthidæ Pfeffer 1900, p. 152, 154; 1908, p. 62, 63; 1912, p. 39.

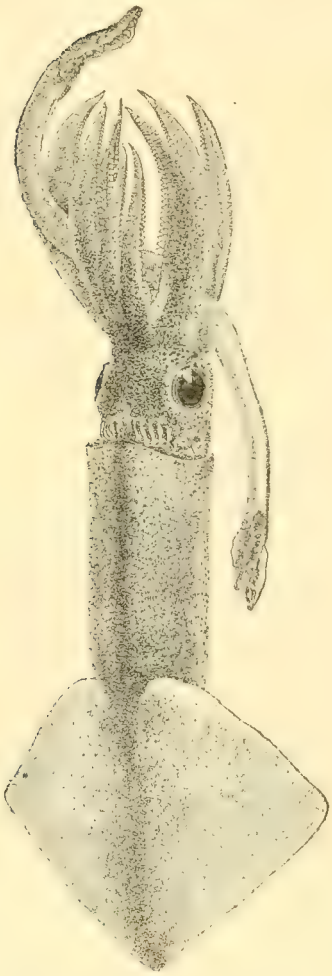

FIG. 31.—*Onychoteuthis banksii*, oblique dorsal view of specimen [227] from near Laysan Island, × ½. Drawn by R. L. Hudson.

Animals of small to gigantic size; body stout, loliginiform. Suckers on sessile arms in two rows and normal throughout. Tentacle club with part of the suckers unmodified, the remainder transformed into hooks; fixing apparatus a compact carpal group of suckers and pads.

Genus ONYCHOTEUTHIS Lichtenstein 1818.

Onychoteuthis Lichtenstein 1818, p. 1591 (*fide* Hoyle); 1818a, p. 223.
Onychoteuthis d'Orbigny 1845, p. 383.
Onychoteuthis Pfeffer 1900, p. 156, 158; 1908, p. 64; 1912, p. 70.

Body of moderate size, cylindrical, tapering. Fins broadly sagittate. Head with a conspicuous "olfactory crest" made up of series of broad longitudinal lamellæ. Arms stout, bearing true suckers only. Tentacles stout, the clubs armed with two rows of hooks on the central part; fixing apparatus a very definite compact rounded group of small suckers and pads on the carpus. No hectocotylization. Gladius narrow and slender, showing through the integument as a well-defined dark streak; a small spoon-shaped cone at the posterior extremity. Hoyle has recently discovered the existence of photogenic organs within the mantle cavity.

Type.—Onychoteuthis Bergii Lichtenstein 1818=*O. banksii* (Leach 1817), a cosmopolitan species.

Onychoteuthis banksii (Leach 1817) Férussac 1826.

Loligo Banskii Leach 1817, p. 141.
Onychoteuthis Banksii Férussac in d'Orbigny 1826, p. 151.
Onychoteuthis Banksii d'Orbigny 1845, p. 386, pl. 26, figs. 1–7.
Onychoteuthis Banksii Schauinsland 1899, p. 92 (locality record).
Onychoteuthis Banksii Pfeffer 1912, p. 70, 758, pl. 3, fig. 13–25, pls. 4–6.
Onychoteuthis banksii Berry 1912, p. 83, figs. 44–46.

This is such an abundant and universal species that I have given above only some of the more particularly relevant references regarding it. For similar reasons the following description is made only complete enough to afford sufficient means for its ready identification.

Body of moderate size, loliginiform, with a pair of large broadly sagittate fins extending a little more than half the length of the mantle. Head small, squarish; ornamented just below the nuchal region with a conspicuous series of about a dozen stout longitudinal lamellæ on either side. Eyes large, with capacious openings.

Arms moderate, stout, outwardly keeled; armed with two rows of small oblique hood-shaped suckers, produced at the upper margin. Tentacles long and stout, the club not expanded except for

the broad marginal membrane; armed with two rows of 9 to 12 hooks each, those of the ventral row in the main conspicuously the larger. Fixing apparatus a compact rounded group of suckers and pads in approximately equal numbers on the carpus. There is a compact cluster of minute suckers at the tip of the club.

Color in alcohol a brownish buff, mottled with slate; a very irregular dark streak on the dorsal aspect marks the position of the gladius.

MEASUREMENTS OF ONYCHOTEUTHIS BANKSII.

	mm.	Length of—	*mm.*
Total length	315	Right second arm	69
Tip of body to dorsal margin of mantle	150	Left second arm	69
Width of mantle	33	Right third arm	71
Width across fins	112	Left third arm	68
Extreme length of fins	87	Right ventral arm	70
Length of fins at plane of attachment	80	Left ventral arm	43+
Length of head	10	Right tentacle	141
Width across eyes	30	Right tentacle club	34
Length of—		Left tentacle	125+
Right dorsal arm	57	Left tentacle club	27+
Left dorsal arm	54	Carpal fixing apparatus	5

Distribution.—"Distribution nearly universal; collected in all the oceans at numerous localities, equally in Arctic and tropical waters." (Tryon 1879, p. 168.)

Neighborhood of Laysan Island (Schauinsland; Stanford University collection).

Material examined.—But a single Hawaiian specimen of this species has been examined. This is no. 2101 of the Stanford University invertebrate series and was taken off Laysan Island by Mr. Max Schlimmer [S. S. B. 227].

Remarks.—I can not find that this Laysan Island specimen exhibits any particular differences from the *O. banksii* I have seen from the Atlantic and elsewhere. So far as can be determined, there appear to have been 11 hooks in each row on the right tentacle club and more than likely on the mutilated left tentacle as well. The fixing apparatus of each tentacle contains 10 suckers and an exactly equal number of pads, a feature which appears to be subject to great variation in this species.

It seems clear that the original spelling of the specific name was the result of an accidental transposition of type, so that the emended version seems preferable. *O. banskii*, *O. banski*, *O. banksii*, and *O. banksi* are abundantly appearing variants in the extensive literature.

This is one of the species of squid preyed upon by the Laysan albatross, and has been previously reported in this connection by Schauinsland.

Genus TELEOTEUTHIS Verrill 1882.

Onykia Lesueur 1821, p. 98.
Onykia Lesueur 1822, p. 296.
Onychia Latreille 1825 (*fide* Gray), not *Onychia* Hubner 1816.
Teleoteuthis Verrill 1882, p. 279, 280.
Teleoteuthis Pfeffer 1900, p. 155, 156; 1912, p. 42, 43.

Animals of small or very moderate dimensions. Tentacle club of young with four rows of suckers, the two median of which become typically modified into hooks in the adult, but in some cases only one of the median rows is noticeably modified, and one of the marginal rows is often very weakly developed. Gladius with broad wings as in *Loligo*.

Type.—*Onykia Carriboea* Lesueur 1821 (species first named); a widespread species originally described from the West Indies.

Teleoteuthis compacta Berry 1913. (Pl. LII, fig. 4, 5.)

Teleoteuthis appellöfi Berry 1909, p. 419 (locality record only), *not* of Pfeffer 1900.
Teleoteuthis compacta Berry 1913, p. 565.

Animal small, loliginiform. Mantle almost cylindrical anteriorly; slightly swollen a little in advance of the middle, thence tapering rapidly to a very acute point. Fins enormous, broadly sagittate in outline, their total width about equal to the length of the mantle; length a little more than half that of the mantle. Mantle margin slightly produced in the medio-dorsal line to form an obtuse point, and a little more prominently in the same way on either side of the funnel; emarginate below the funnel.

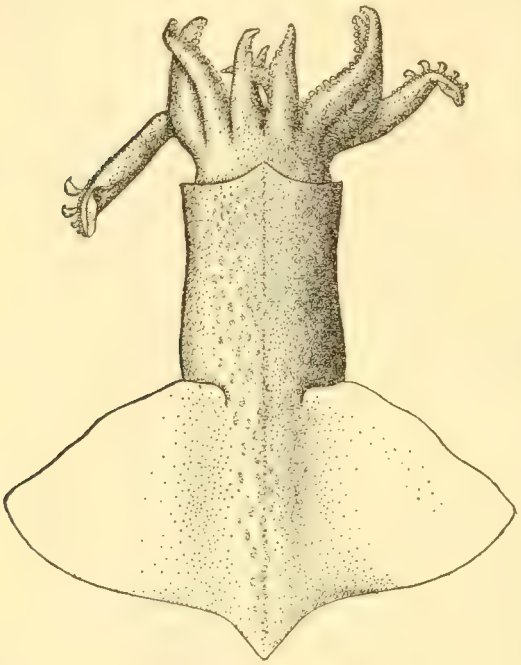

FIG. 32.—*Teleoteuthis compacta*, dorsal view of type [238], × 3.

Head squarish, narrower than the mantle, into which it may be almost completely withdrawn. Eyes little prominent; their lid openings small, notched in front.

Arms short, stout, little attenuate; unequal, their order of length 3, 2, 4, 1; the dorsal arms clearly shorter than those of the second and third pairs. Suckers on all the arms small, rotund, closely ranked in two widely interspaced series. (Pl. LII, fig. 5). Umbrella wanting, but all the arms well angled, and the third pair furnished externally with a strong membranous keel.

Tentacles short, stout, but little exceeding the arms; clubs not thickened, but broadly keeled above and slightly so along the ventral margin; both suckers and hooks present on the club; hooks sessile, 10 to 11 in number and in a single longitudinal series, comprising the more ventral of the two median rows of acetabula; first five hooks quite small, the next three much larger, the distal ones diminishing again; the two dorsal rows of suckers irregular, the first five pairs small and closely placed, the succeeding ones slightly larger and more distant, becoming smaller again distally; the suckers of the inner dorsal row persist in alternation with the hooks to the tip of the club, but the marginal row becomes obsolete distally and comprises only about eight suckers in all; suckers of the ventral row exceedingly minute, especially distally where they are placed very far apart. The extreme tip of the tentacle is occupied by a group of excessively minute suckers, which are scarcely visible as such with an ordinary hand lens. Fixing apparatus well developed, comprising a quadruple series of small suckers and pads in alternation; about 8 pads and 12 suckers can be made out. (Pl. LII, fig. 4.)

Gladius delicate, the expanded wings greatly narrowing in front of the hollow terminal cone.

Color in alcohol a brownish buff. Chromatophores light brown, scarcely visible below.

MEASUREMENTS OF TELEOTEUTHIS COMPACTA.

	mm.	Length of—	*mm.*
Total length including tentacles	28	Dorsal arms	4.5
Tip of body to dorsal mantle margin	21	Second arms	5.5
Width of body	6	Third arms	6
Width across fins	20	Ventral arms	5
Extreme length of fins	12	Left tentacle	7
Length of fins at base	11	Tentacle club	3.5
Width across eyes	5		

Type.—Catalogue No. 214381, United States National Museum [S. S. B. 238].

Type locality.—*Albatross* station 3989, 385 to 733 fathoms, vicinity of Kauai Island, coral, sand and rock bottom, June 11, 1902; one specimen.

Distribution.—Hawaiian Islands (*Albatross*).

Specimens examined.—The type is unique.

Remarks.—It was at first thought that this specimen might be referable to the *T. appellöfi* of Pfeffer and was indeed so listed in a preliminary paper, but a more careful study of details, particularly those of the tentacular armature, has convinced me that the present species is distinct and stands rather nearer to M. Joubin's *T. caroli* (1900, p. 64), from which it differs in the relatively larger fins and shorter and differently armed tentacle club.

The latter structure is a curious affair and is better to be understood from the figure than from my description. It offers several apparent divergencies from that of *T. caroli* as figured by Joubin (1900, pl. 11, fig. 10), especially in the fixing apparatus, for *T. caroli* is represented as having but seven suckers (pads are omitted from the drawing but mentioned in the text). Furthermore, the suckers of the club itself are very different in number and arrangement, although the two forms agree in the presence of but a single series of hooks.[a] In *T. caroli* the fifth hook from the base attains the maximal proportions, while in our species it is the sixth, and the change in size at this point is conspicuously more abrupt.

It is, however, not at all impossible that the single row of hooks and the broad fins are juvenile characters, the former being intermediate between the hookless condition described by Pfeffer as *Steenstrupiola* (cf. Pfeffer 1900, p. 156) and the normal adult, in which case the Hawaiian specimen may after all prove to be closer to the *T. peratoptera* d'Orbigny, a Chilean species which was indeed originally figured with three rows of suckers and but one series of hooks (d'Orbigny 1835, pl. 3, fig. 6), though since united by d'Orbigny himself with the *T. platyptera* of the same region.

T. appellöfi has fins of somewhat similar proportions, but the structure of the tentacle club is totally different.

Family ENOPLOTEUTHIDÆ Pfeffer 1900.

Enoploteuthidæ Pfeffer 1900, p. 152, 163.
Enoploteuthidæ Chun 1910, p. 52.
Enoploteuthidæ Pfeffer 1912, p. 118.

Animals of small to moderate size. Arms with two rows of suckers, part of which typically are modified into hooks. Tentacles with clubs little or not at all expanded; their suckers in four rows (one or more of these often suppressed in the adult) and usually part of them transformed into hooks; a carpal fixing apparatus present comprising a few suckers and pads. Buccal membrane eight-pointed. Gladius feather-shaped; with broad somewhat angular wings and no end cone. Photogenic organs are almost invariably present on the ventral aspect of the eyeball, and in addition may occur within the mantle cavity or scattered over the ventral surface of the outer integument.

Subfamily ENOPLOTEUTHINÆ (Chun 1910) Pfeffer 1912.

Enoplomorphæ Chun 1908, p. 86.
Enoploteuthinæ Tribus *Enoplomorphæ* Chun 1910, p. 56, 78.
Enoploteuthinæ Pfeffer 1912, p. 124, 125.

Body more or less pointed posteriorly but not spitlike. Fins large and usually sagittate. Buccal membrane free; dorsal lappets well separated. Photogenic organs occur, often in large numbers, on the ventral aspect of the mantle and usually the head and arms as well; in most genera a conspicuous single series of large organs is found on the ventral periphery of the eyeball; no luminous organs in the pallial chamber.

[a] Joubin (op. cit., p. 65) states that the hooks of *T. caroli* are in two rows, but it seems to me that the "première série" described as "très petits, longuement pédonculés" are better interpreted as suckers as I have done.

Genus ABRALIA Gray 1849.

Abralia Gray 1849, p. 46, 50.
Abralia Pfeffer 1900, p. 166, 167.
Asteroteuthis Pfeffer 1908a, p. 292.
Abralia Chun 1910, p. 57.
Asteroteuthis Pfeffer 1912, p. 124, 128.
Abralia Pfeffer 1912, p. 762.

Fins large, sagittate; more or less pointed posteriorly, and not exceeded by the tip of the pointed body. Arms with two rows of hooks throughout the greater part of their length, but with true suckers at their tips; extremities of ventral arms normal. Left ventral arm hectocotylized. Dorsal row of suckers on proximal portion of tentacle club suppressed in adult, leaving one row of hooks and two rows of suckers which give way to four rows of suckers distally. Buccal membrane in preserved specimens pale and scattered over with reddish chromatophores.

Type.—Onychoteuthis armata Quoy and Gaimard 1832 (species first mentioned); described from near the island of Celebes.

Abralia astrosticta Berry 1909. (Pl. LI.)

Abralia astrosticta Berry 1909, p. 412, 419, fig. 4–7.
Abralia astrostricta Weindl 1912, p. 271–275.
Abralia (Compsoteuthis) astrosticta Pfeffer 1912, p. 149, 151, 163.

Animal of small size. Mantle firm, fleshy, cylindrical in shape, little compressed; tapering at first gradually, then more abruptly to a bluntish point posteriorly. Anterior edge of mantle smooth, emarginate below the funnel, and with a very slight obtuse medio-dorsal angle. Fins moderately large and very wide in proportion to their length; about one-third as long as the mantle, and each one about as broad as long; subterminal, triangular; attached firmly along the inner margin for most of their length; anterior lobes prominent, but posterior margins nearly straight and converging at a very obtuse angle.

Head rather large, but decidedly narrower than the body, squarish, flattened above and below; "olfactory crest" comprising a series of four oblique fleshy folds behind the eye on either side. Eyes large; the circular lid opening with a minute rounded sinus in front. Funnel large, subtriangular, very firm and thick-walled, its center rounded and conspicuously swollen ventrally. Funnel organ well developed, posterior in position; comprising a V-shaped median pad on the interior dorsal wall, and a small elongate-ovate pad placed ventro-laterally to it on either side. The tip of the funnel is furnished with a wide shallow flaplike valve. (Pl. LI, fig. 8.)

On its inner surface the edge of the mantle articulates with the head in the nuchal region and with the base of the funnel on either side by cartilages of the form usual in the genus. The dorsal apparatus consists of a simple longitudinal ridge on the mantle and a corresponding plate on the neck. The funnel cartilages are elongate, slightly widest near the base, have a thickened, raised and reflexed margin, and their grooves are simple, narrow, deep, and elongate (pl. LI, fig. 7); they fit over a slender linear ridge on either side of the inner surface of the mantle.

Sessile arms stout, little attenuate; nearly of a length, but the second arms slightly the longest and stoutest, and the dorsal pair a little shorter and more slender than the others, so that the formula of their relative length is in general 2, 4, 3, 1; outer edge of arms angled and furnished with a keel, membranous and poorly developed on the four dorsal arms, but increased to a fleshy carina on the arms of the third pair and more particularly along the outer aspect of the ventral arms, where it is so heavy and conspicuous as to cause these arms to appear almost twice their true diameter when viewed ventrally. For the greater part of their length all the arms are armed with two widely spaced alternating rows of small hooks which are replaced on the extreme distal portions by a double series of minute crowded suckers; the tips of the ventral arms bear suckers similar to those of the other arms and are indeed entirely normal in every particular; the number of pairs of hooks on the ventral arms is about eight.

Tentacles slender, over half as long again as the arms, cylindrical, little tapering. Club but little expanded, armed with four rows of acetabulæ which respectively may be described as follows: (1) On the distal half of the club all four rows consist of small suckers of about equal size at any given transection

of the arm, but regularly diminishing to the tip; (2) the two dorsalmost rows continue down the club proximally for its entire length, attaining their maximum dimensions near the middle; the two ventral rows on the other hand abruptly cease and are replaced on the proximal half of the club by (3) a single series of five rather large hooks which stand opposite the five proximal pairs of suckers in the dorsal rows; (4) at the base of the club, upon the carpus, is a very definite fixing apparatus comprising a double row of some four to five suckers alternating with a similar number of small whitish pads. (Pl. LI, fig. 2, 6.)

Buccal membrane eight-pointed (as correctly surmised by Pfeffer, my original assertion that there are but seven lappets is erroneous); coarsely papillose within.

Photophores of the outer integument exceedingly numerous and readily perceivable to be in two main sizes, the grouping of the larger of which is distinctly bilaterally symmetrical and varies on different regions of the body as follows:

(1) On the ventral aspect of the mantle appear about ten rather ill-defined longitudinal series of these organs, including (*a*) two nearly median rows of relatively large organs extending without interruption from the anterior mantle margin to the posterior extremity; (*b*) two similar series succeeded laterally by two or three others, composed of organs constantly diminishing both in size and number, occur parallel to these anteriorly, but all converge posteriorly in such a way that in addition to the two central series but one other row persists on each side to the tip. The organs of the various series are very regularly and equally interspaced so that there is a certain tendency evident for the grouping to occur in a transverse as well as a longitudinal direction. Aside from the effect which might well be expected to result from such a tendency, no specially definite line of photophores is found bordering the margin of the pallial aperture. The smaller organs are much more numerous than the larger and occur scattered between and among them in a much more irregular fashion. On the dorsal surface of the mantle photogenic organs are almost entirely wanting, but there is a fairly regular series of about seven small distant organs close to the median longitudinal line on either side, and some distance lateral to these a few (3 to 4) isolated organs, perhaps representing the rudiments or forerunners of other longitudinal series.

(2) The ventral aspect of the funnel exhibits a little in front of its middle a transverse line of four large organs of equal size, in front of and behind which occur a number of smaller ones in such a way as to form four longitudinal series containing one of the large organs and two to three of the smaller ones each. A few scattered organs occur in addition, but all are bilaterally arranged. A clear space down the center of the funnel separates the photophores of each side into two triangular patches. This space, like the extreme tip of the funnel, is colorless and devoid of organs.

(3) There are no photophores upon the upper surface of the head, but upon the lower aspect they appear with perfect symmetry in five longitudinal rows with an additional series bordering each ocular aperture. Here also the larger organs are relatively few in number compared with the smaller, there being only two of the former in the median row, and two to three in each of the lateral series. The median row bifurcates at the apex of the funnel groove (one large organ on either side), and also anteriorly, where either branch parallels a continuation of the first lateral series along each ventral arm to its extremity. The outer lateral series continues for a distance along the border of the membranous keel, so that the basal half of each ventral arm bears in all three rows of photophores. The arms of the third pair have a series of these organs near the base along their ventral aspect, and there are evidences of a second row of smaller ones along the dorsal margin as well. No such structures have been identified upon any of the other arms or upon the tentacles.

All of the photophores appear as minute, but definite, faintly elevated, circular, bluish rings, surrounding a white dotlike center, and having much the appearance of minute eyes. The bluish rings are relatively heavier and more conspicuous in the larger organs, while the smaller organs are by this means again separable into two types, the one much less heavily pigmented than the other.

In addition to photogenic organs of the general type described above, there are to be observed a very conspicuous series of five large reddish bead-like structures upon the ventral periphery of each eyeball. They are placed very close together, are of circular outline and subequal in size (pl. LI, fig. 3). The two terminal organs are considerably lighter in color than the three median ones.

Prevailing color of animal preserved in alcohol, a pale buff brown; the gladius showing through the dorsal integument as a very prominent medio-longitudinal line. Chromatophores brownish; most numerous on the upper surface of the head, which is thus rendered very dark in color; much less numerous on the dorsal aspect of the mantle and below largely replaced by the bluish photophores which are strongly contrasted with the chromatophores in color. Buccal membrane almost uniformly pale, with only a few scattered chromatophores.

Gladius with a thickened midrib; wings unthickened, very delicate, and with distinctly angular margins.

MEASUREMENTS OF ABRALIA ASTROSTICTA.

	mm.
Total length	65
Length exclusive of tentacles	56.5
Length of mantle, dorsal	34
Extreme length of fins	11
Length of fins at base	9
Width across fins	22
Width of mantle	10
Width of head	9
Length of—	
Head	8
Right dorsal arm	11
Left dorsal arm	11
Right second arm	13
Left second arm	15
Right third arm	12
Left third arm	12
Right ventral arm	13
Left ventral arm	13.5
Tentacle	23
Tentacle club	4
Funnel	6.5

Type.—A female; catalogue No. 214313, United States National Museum [S. S. B. 171].

Type locality.—*Albatross* station 4122, 192 to 352 fathoms depth, off Barbers Point Light, Oahu, bottom of coarse coral sand and shell, July 26, 1902; one ♀ specimen.

Distribution.—Hawaiian Islands (*Albatross*).

Material examined.—No other specimens than the type are known.

Remarks.—This very beautiful little squid is a member of a rare and exceedingly curious group of cephalopods which have been sparsely taken at divers times and in many widely separated localities, and the interrelationships of which are by no means as yet clearly understood. They are Enoploteuthids chiefly characterized by the double row of hooks on the arms supplanted distally by suckers, and the extensive development of photogenic organs over the entire ventral surface of the head and body, though not within the mantle cavity, as in the case of certain forms similar to some which will be described later. The peculiar features of the group were first recognized (although only partially) by Gray, who in 1849 founded the genus *Abralia* for their reception. Many years later (Joubin 189[illegible]) a second genus, *Abraliopsis*, was erected for the reception of certain *Abralia*-like forms, unique in the possession of a conspicuous series of pigmented swellings at the tips of the ventral arms, and further distinguished by the deep violet color of the buccal membrane, somewhat different structure of the tentacle club, bilaterally symmetrical arrangement of the photophores, and the presence of three instead of two series of these organs upon the ventral arms. A few years ago Pfeffer, on the supposition that the type species of Gray (*A. armata* Quoy and Gaimard) would be found congeneric with *Abraliopsis*, replaced that term by *Abralia* and advanced the new name *Asteroteuthis* for the group thus left without a cognomen. More recently, however, he has once more returned to the older and more familiar arrangement, for upon examination the type specimen of *A. armata* proved that species to be after all an *Asteroteuthis* or true *Abralia* in the accepted sense.

The position of the Hawaiian species now under consideration is in many respects anomalous. Since the tips of the ventral arms are entirely normal, bear suckers at their extremities, and lack all indications of terminal pigmented organs, it is most decidedly not an *Abraliopsis* and Pfeffer's suggestion that the specimen represents a very large *Compsoteuthis* stage of that genus is quite untenable. This is further borne out by the fact that the buccal membrane is not deep violet in color, but pale and dotted with chromatophores, while the main features of the armature of the tentacle club are those of a typical *Abralia*. On the other hand no previously described *Abralia* shows so strikingly symmetrical an arrangement of the photogenic organs on the mantle, or possesses more than two series of these structures on the ventral arms, or has such extremely short and wide fins. In almost every respect, therefore,

A. astrosticta is a remarkably distinct species and is not closely approached by any other known form excepting possibly the very recently described *A. steindachneri* Weindl 1912 of the Red Sea, which is thought by its author to be somewhat nearly related. A complete account of the latter species has not yet reached me, but from the preliminary notice above cited it would seem that this is the case, although the two forms differ in enough particulars to be sufficiently distinct. In Weindl's species the fins are not quite so short and wide, there are seven to eight hooks on the tentacle club, and the median photophore on the eyeball is said to be much the smallest.

It has seemed worth while to make the account of this species as full as possible, firstly on account of the special interest attaching to forms of this group, and secondly because of the unusually fine condition of the present specimen which renders the chance for misinterpretation correspondingly slight.

Abralia trigonura Berry 1913.

Abralia species Berry 1909, p. 419 (locality record only).
Abralia trigonura Berry 1913, p. 565.

There is a second specimen of *Abralia* in the *Albatross* collection, which, although not very well preserved, is clearly not referable to *A. astrosticta*, but belongs rather to the typical section of the genus.

Animal of small size, in general loliginiform, but the mantle rather short, wide, inflated, and rapidly tapering to a point posteriorly. Fins large, a little over half as long as the mantle; their total width about approximates the length of the mantle.

Head rather small, squarish; olfactory crests low (crushed, and not distinct). Eyes large and prominent. Funnel large, triangular, compressed. Funnel organ well developed; similar in general arrangement to that of *A. astrosticta*, except that the lobes of the median (dorsal) pad are broader, and the ventro-lateral cushions are ovate and conspicuously larger (fig. 33). The funnel has a delicate foldlike valve at the tip.

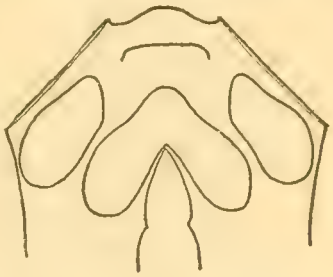

FIG. 33.—*Abralia trigonura*, outline drawing of funnel organ [275], × 3.

Arms quite long, over two-thirds the length of the body; subequal, but the dorsal pair distinctly the shortest; order of length in general 2, 4, 3, 1. The arms bear two rows of small alternating hooks, which are replaced by suckers at the extremities.

Tentacles very long and slender, the clubs little expanded. The armature is almost entirely effaced, but a single hook persisting on one of the clubs is much longer, more slender, and much more curved than those of *A. astrosticta*.

Buccal membrane large; eight-pointed; papillose and uniformly pale within; its outer surface conspicuously dotted with many small, distinct, dark reddish chromatophores.

The gladius as compared with that of *A. astrosticta* is similar in general shape, but is relatively much flatter and less slender, with, however, a wider and more robust midrib; the lateral expansions are conspicuously broader and their angles more pronounced and more anterior in position.

The photophores of the ventral integument are of a very different aspect than those of *A. astrosticta*, but here also they are apparently of two main types. The larger appear as small whitish tubercles, which, under the microscope, show a lenslike core of chalky white color inclosed by a pale bluish gray ring. The smaller organs are either (1) conspicuously darker, comprising a light bluish core surrounded by a narrow dark ring distinctly composed of separate bodies of pigment, or (2) but slightly darker and resembling the large organs in miniature. The integument of the mantle has mainly sloughed away, but from the portions remaining there appear to have been two very definite parallel rows of the larger organs running down the medio-ventral line, with at least two other series on either side more or less parallel to them. The smaller organs are exceedingly numerous and heavily distributed among the larger all over the ventral surface.

The funnel shows two large triangular groups of numerous organs symmetrically disposed. As in *A. astrosticta* four of these only are of the larger type, but in this species they do not lie in a single transverse line. The tip of the funnel is colorless and devoid of photophores. The number of these organs on the head and arms is no longer to be made out.

Subocular organs are present, but the eyes are so damaged that their exact number and position can not be made out with certainty. They appear, however, to be relatively small and distant from one another.

Color everywhere a brownish buff, heavily clouded with dark reddish chromatophores which are numerous even over the ventral surface. These combine with the bluish photophores to give a purplish cast to the entire animal.

MEASUREMENTS OF ABRALIA TRIGONURA.

	mm.	Length of—	*mm.*
Total length	93	Head	11
Length excluding tentacles	68	Dorsal arm	18
Length of mantle, dorsal	28.5	Second arm	22
Extreme length of fins	17	Third arm	20
Length of fins at base	15	Ventral arm	21
Width across fins	29	Tentacle	49
Width of mantle	13	Tentacle club	8?
Width of head	11	Funnel	9

Type.—Catalogue no. 214387, United States National Museum [S. S. B. 275].

Type locality.—*Albatross* station 4087, 306 to 308 fathoms, off Mokuhooniki Islet, northeast entrance to Pailolo Channel, fine gray sand bottom, July 21, 1902; one specimen.

Distribution.—Hawaiian Islands (*Albatross*).

Material examined.—The unique type is the only specimen known.

Remarks.—Although in a rather badly macerated condition, as though taken from the stomach of some larger animal, the single specimen seen still retains enough of its original appearance to show features which forbid its reference to any of the previously described species of either *Abralia* or *Abraliopsis*. The lack of terminal organs on the ventral arms and the pale red-dotted buccal membrane alone serve to establish its identity as an *Abralia*, while the large fins indicate that it will prove to belong to the typical section of that genus. The species to which *A. trigonura* most closely approximates seems to be the *A. andamanica* Goodrich from the Bay of Bengal. The mantle of the Hawaiian species, however, appears to be relatively shorter and much more rapidly tapering, and such of the photogenic organs as can be made out fail to coincide in their arrangement with the description given by Goodrich, who fails to mention the definite series of these organs which here adorn the ventral aspect in so conspicuous a fashion that they can scarcely have been overlooked.

From the other known Hawaiian species, *A. astrosticta*, it is widely different. The short conical body, larger fins, more numerous small luminous organs on the ventral surface, and much smaller subocular organs are sufficient to distinguish it at a glance. As the specimens obtained of the two species are not very far from one another in size, it is evident that one can not be regarded as but a younger stage of the other.

Genus ABRALIOPSIS Joubin 1896.

Abraliopsis Joubin 1896, p. 19.
Abraliopsis Pfeffer 1900, p. 166, 168.
Abralia Pfeffer 1908a, p. 289–292.
Abraliopsis Chun 1910, p. 57, 78.
Abralia Pfeffer 1912, p. 124, 137.
Abraliopsis Pfeffer 1912, p. 764.
juv.=*Compsoteuthis*+*Microbralia* Pfeffer 1900, p. 165, 167.
juv.=*Nepioteuthion*+*Prodromoteuthis* Pfeffer 1912, p. 149, 151, 165, 167.

Fins large, sagittate; acutely pointed posteriorly, and not exceeded by the tip of the equally pointed body. Arms with two rows of hooks throughout the greater part of their length, but with true suckers

at the tips of all the arms, as in *Abralia*, except the ventral pair which bear only hooks; extremities of ventral arms with a conspicuous series of heavily pigmented black bead-like organs probably photogenic in function. Left ventral arm hectocotylized, but distinguished chiefly by its very wide web with broad lappets at the margin; no glandular swellings. Two rows of suckers on proximal portion of tentacle club suppressed in adult, leaving either two rows of hooks or one row of hooks and one row of suckers, which give way distally to four rows of suckers. Buccal membrane deep violet in color. Photogenic organs of the mantle usually showing a definite bilateral arrangement; three rows of these organs present on the lower aspects of the ventral arms, two occurring on the arm itself, the other upon its marginal web. A single series of five large photophores occurs upon the ventral periphery of the eyeball, the terminal organs of this series being somewhat larger than the remainder.

Type.—Enoploteuthis Hoylei Pfeffer 1884 (designation); described from the Mascarene Islands.

Abraliopsis species (young).

Abraliopsis species Berry 1909, p. 419 (mere locality record).

Animal small. Mantle short, acutely conical, widely flaring in front. Fins relatively enormous, over two-thirds the length of the mantle and notably wider when taken together than the latter is long, anterior lobes prominent and angular.

Head small; only broader than long because of the large conspicuous eyes. Funnel flattened, little projecting.

Arms rather long, very slender and attenuate; decidedly unequal, their formula 4, 2, 3, 1; the ventral arms conspicuously longer than the others, the dorsal pair notably the shortest. Armature consisting of two alternating series of small elevated hooks, the latter persistent nearly to the tips of the arms, so that the usual suckers at the extremities are very small and obscure and have not in the present case been actually observed by me.

Buccal membrane eight-pointed; its coloration violet throughout except for the paler and more whitish trabeculæ.

Photogenic organs of mantle conspicuous and exhibiting a very definite grouping, not even the smaller ones being very irregularly scattered; on the ventral surface of the mantle occur six very definite rather distant converging series, with traces of another row as represented by three or four widely spaced organs lateral to these. On the head three conspicuous rows (the only ones shown in the figure) with another weaker row lateral to these and a rather weak circle around the eyelid opening, making seven rows in all. Along the ventral aspect of the ventral arms there are two rows and one row on the third pair.

FIG. 34.—*Abraliopsis* sp., young, ventral view [276], × 2. Drawn by R. L. Hudson. The representation of the photogenic organs is incomplete.

The ventral arms bear at their extremities a bead-like series of three distinctly separate smooth black ovoid swellings, the median one notably the largest.

The subocular organs are yellowish in color but too badly damaged to be made out very clearly.

Color in alcohol a brownish buff; the chromatophores darker but comparatively few in number. Photophores bluish with paler centers.

MEASUREMENTS OF ABRALIOPSIS SPECIES (YOUNG).

	mm.		mm.
Total length exclusive of tentacles	35	Length of—	
Length of mantle, dorsal	16	Head	5
Extreme length of fins	11	Dorsal arm	7
Length of fins at base	9	Second arm	12
Width across fins	19	Third arm	11
Width of mantle near anterior margin	7	Ventral arm	15
Width of head	6	Funnel	5

Material examined.—The single specimen was taken from the surface at *Albatross* station 3926, latitude 21° 13′ N., longitude 158° 41′ W., between Honolulu and Laysan Island [S. S. B. 276].

Remarks.—This specimen is clearly immature and withal very poorly preserved. The tentacles are missing and the integument disfigured with a whitish deposit, badly obliterating some of the important features. It is undoubtedly a young *Abraliopsis*, however, and is very close to the stage described by Pfeffer as *Micrabralia*.

Subfamily PYROTEUTHINÆ Pfeffer 1912.

Pterygiomorphæ Chun 1908, p. 86.
Pterygiomorphæ Chun 1910, p. 58, 108.
Pyroteuthinæ Pfeffer 1912, p. 124, 189, 773.

Body sharply pointed posteriorly, notably exceeding the large round separate fins. Buccal membrane joined with the basal web of the arms; dorsal lappets close together and coherent at base. Photogenic organs lacking from the outer integument, but numerous and polymorphic on the eyeball as well as within the pallial chamber.

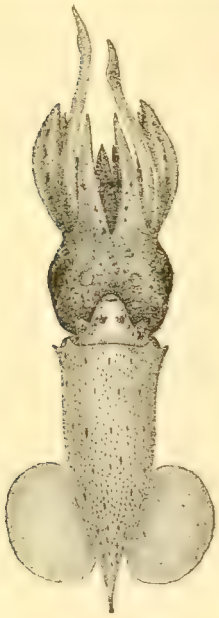

FIG. 35.—*Pterygioteuthis microlampas*, ventral view of female [278]. × 2. Drawn by R. L. Hudson.

Genus PTERYGIOTEUTHIS H. Fischer 1895.

Pterygioteuthis H. Fischer 1895, p. 205.
Pterygioteuthis Pfeffer 1900, p. 165, 166.
Pterygioteuthis Hoyle 1904, p. 39.
Pterygioteuthis Chun 1910, p. 58, 108.
Pyroteuthis (*Pterygioteuthis*) Pfeffer 1912, p. 193, 204, 774.

Ventral arms naked or with suckers only; remaining arms with a few of the middle suckers transformed to hooks. Tentacle club with four rows of suckers and no hooks; fixing apparatus composed of a very few suckers and pads. Left ventral arm hectocotylized, and furnished with a conspicuous glandular fold or swelling.

Type.—*Pterygioteuthis Giardi* Fischer 1895 (monotypic); described from off the coast of Morocco.

Pfeffer has placed this genus under *Pyroteuthis* Hoyle 1904 as a subgroup; but even should this arrangement be accepted as zoologically correct, the name *Pterygioteuthis* has nine years' priority and should therefore be given precedence.

Pterygioteuthis microlampas Berry 1913. (Pl. LII, fig. 1–3.)

Pterygioteuthis giardi Berry 1909, p. 419 (locality record only).
Pterygioteuthis microlampas Berry 1913, p. 566.

Animal small, fragile, with a cylindro-conical body terminating posteriorly in a sharp spinelike process, which extends between the fins and well past them; mantle about one-third as wide as long. Fins rather large, prominent, longer than broad, circular, not adnate, attached along their inner margins for less than half their total length; anterior and posterior lobes about equal.

Head large, rounded, but little narrower than the mantle. Eyes large, prominent. Funnel large, broadly conical in outline; aperture small.

Arms short, nearly of a length, their order of relative length 3, 2=4, 1; outwardly keeled by a very fragile trabeculated membrane (most conspicuous on the arms of the third pair). Dorsal arms bare for the basal one-fourth of their length; at this point occur two very minute somewhat distant suckers, succeeded distally by six pairs of much larger suckers alternating in two series; the ventral members of the succeeding three pairs are transformed into hooks, after which the remaining suckers (about eight in number) steadily diminish in size to the extremity of the arm, there being 14 pairs of suckers or their homologues on the entire arm; distally a wide delicate trabeculated membrane (mostly torn away) occupies the ventral margin of the sucker-bearing area; the larger suckers have about four large long bluntly squarish teeth along the upper border of their horny rings. Arms of second and third pairs essentially similar in all respects to the dorsal arms, although larger and stouter. Ventral arms squarish,

much more slender, more acutely tapering; hooks entirely lacking; suckers exceedingly minute, occurring in two distant narrowly spaced rows of 10 to 14 suckers each, which are confined to the more distal portion of the arm.

Tentacles short, stout, cylindrical, but little longer than the arms; near the base of the stalk a conspicuous circular constriction, beyond which the stalk swells out again, attaining a diameter even greater than that of the proximal portion, thence tapering gradually to the short blunt unexpanded club. Suckers on inner surface of club minute, in four rows; the five proximal members of the dorsal row distinctly the largest, even exceeding in size the two suckers on the carpus, which together with two small pads constitute the fixing apparatus. (Pl. LII, fig. 3.)

FIG. 36.—*Pterygioteuthis microlampas*, diagram to show arrangement of photogenic organs of left eyeball [277], × 5.

Subocular photophores numerous, at least 14 on each eyeball, but in the present material exceedingly difficult to locate with certainty, due to the ease with which they become detached upon the removal of the outer lid. Most conspicuous are two very large circular organs situated one just behind the other on the ventral periphery of the eyeball, just in front of the funnel (fig. 36, no. 8 and 9). Well anterior to these and more or less in line with them are four very much smaller organs (nos. 11–14). Just posterior to the lens is a large conical organ (no. 10), while a conspicuous series of seven moderately large organs form an oblique curve in front (nos. 1–7). Of the latter the three upper (nos. 1–3) are very large and conical in outline: the next two and the last one are smaller, but the next to the last one (no. 6) is large flattened, of ovate outline, and pale in color, very different in appearance from any of the other organs. (See also pl. LII, fig. 1.)

Color in alcohol a grayish buff, the chromatophores somewhat darker. Buccal membrane purplish, with paler trabeculae. The gladius shows through the dorsal integument as a prominent median line.

MEASUREMENTS OF PTERYGIOTEUTHIS MICROLAMPAS.

Number in author's register	277	278	Number in author's register	277	278
Sex	♀	♀	Sex	♀	♀
	mm.	*mm.*		*mm.*	*mm.*
Total length	31	.....	Length of—		
Tip of body to tip of arms	28	.....	Head	4	.....
Length of mantle, dorsal	18	.....	Dorsal arm	6.5	7
Width of mantle	6	6	Second arm	7.5	8
Extreme length of fins	8	.....	Third arm	8	8
Length of fins at base	3.5	.....	Ventral arm	7.5	7.5
Width across fins	14	.....	Tentacle	12	.....
Width across eyes	5.5	7			

Type.—Catalogue No. 214386, United States National Museum [S. S. B. 277].

Type locality.—*Albatross* station 4105, in 314 to 335 fathoms, Kaiwi Channel, bottom of fine coral sand and foraminifera, July 24, 1902; one ♀ specimen.

Distribution.—Hawaiian Islands (*Albatross*).

SPECIMENS OF PTERYGIOTEUTHIS MICROLAMPAS EXAMINED.

No. of specimens.	Locality.	Depth in fathoms.	Collector.	Sex.	Where deposited.	Author's register.
[a] 1	Kaiwi Channel	314–335	Albatross Sta. 4105	♀	U. S. Nat. Mus. Cat. 214386	277
1	No locality	(?)	Albatross Sta. (?)	♀	Fragmentary	278

[a] Type.

Remarks.—Only two species of *Pterygioteuthis* have been recognized previous to the present one. The first of these and type of the genus is the *P. giardi* Fischer, originally described from a specimen taken by the *Talisman* at a depth of 1105 meters off the coast of Morocco. In 1904 Hoyle published a much more detailed account of some specimens thought to represent the same species which were captured by the *Albatross* in the eastern tropical Pacific at depths ranging from 551 to 1,201 fathoms. In 1908 Chun issued a brief diagnosis of a second species, *P. gemmata*, which was secured by the *Valdivia* expedition in the South Atlantic. When the present specimens from the *Albatross* Hawaiian collections were first being examined by the writer, Chun's paper had not yet come to hand, so that they were, after a little hesitation, referred to *P. giardi* and were indeed recorded under this name in a preliminary publication. Since that time the appearance of the great monograph of the *Valdivia* Oegopsids by Chun has greatly increased and simplified our understanding of the genus, so that upon a reexamination of the specimens and a patient working out of the details (often seriously obscured by the woeful preservation of the material) the conclusion was reached that a new species is represented, which though in many respects very close to *P. giardi*, in some ways shows an approach to *P. gemmata*, and in others is somewhat different from either. The relationship of the three species is well shown by a consideration of their more important diagnostic characters grouped in parallel columns.

DIAGNOSTIC CHARACTERS OF THE SPECIES OF PTERYGIOTEUTHIS.

P. giardi.	P. microlampas.	P. gemmata.
15 subocular organs; the 5 small anterior ones nearly in line with one another	14 subocular organs; arrangement similar to *P. giardi*, but 4 instead of 5 small anterior organs, and the last of these not in line with the others.	14 subocular organs; arrangement very different.
Dorsal arms with 3 hooks near middle of arm (both rows affected) and about 5 pairs of suckers proximally; 2d and 3d arms with 2–3 hooks (both rows). No suckers at tips of any arms save dorsal pair.	Dorsal arms with 3 hooks near middle of ventral row, with 6–7 pairs of suckers proximally; 2d and 3d arms with 3 hooks in ventral row and 7 suckers proximally; suckers continuing distally to tips.	Dorsal, 2d, and 3d arms with 4–5 hooks near middle of ventral row.
Ventral arms devoid of both hooks and suckers.	Ventral arms with no hooks; suckers minute and confined to distal half of arm.	Ventral arms with no hooks; but with small suckers throughout their length.
Two suckers in fixing apparatus	Two suckers in fixing apparatus	Three suckers in fixing apparatus.
Chitinous plate between the glandular ridges of the hectocotylus bidentate.	Hectocotylus unknown	Chitinous plate between the glandular ridges of the hectocotylus finely toothed.

It is an unfortunate but curious fact that practically all of the specimens of this genus which have been obtained have been defective in one way or another. As a rule either the eyes have burst or the arms are badly damaged or both types of mutilation have occurred. This appears to be due to the fragile and incoherent nature of the tissues, which seem unable to withstand the great changes in pressure which they are forced to undergo in being pulled up from the depths in which they live. According to present evidence it appears that even in a preserving medium they are apt to gradually disintegrate, and despite the utmost vigilance and care the handling necessarily incidental to a thorough examination is often fatal. This was the case with the specimen which was the subject of Mr. Hudson's excellent drawing, for though evidently perfect at that time, it was in such fragmentary condition when it came into my hands that no accurate description of it could be given and it became necessary to utilize the second individual as the type, although the account of the photogenic organs of the eye has been mainly drawn from the former specimen.

I can not forbear adding that there are certain discrepancies in the various descriptions given by Fischer, Joubin, Hoyle, and Chun for *P. giardi* which cause me to feel some doubt as to whether all their specimens are really referable to the same species, an uncertainty which is by no means diminished when the localities furnishing the respective specimens are taken into consideration.

Family HISTIOTEUTHIDÆ Verrill 1881.

Histioteuthidæ Verrill 1881, p. 431.
Histioteuthidæ Pfeffer 1900, p. 152, 168.
Histioteuthidæ Pfeffer 1908, p. 75.
Histioteuthidæ Chun 1910, p. 147.
Histioteuthidæ Pfeffer 1912, p. 243.

Body short, barrel-shaped; mantle thickened and fleshy. Fins relatively small, subterminal. None of the suckers on either arms or tentacles modified into hooks; two rows of suckers on sessile arms; on tentacle club more than four rows. Fixing apparatus a series of small suckers and pads extending across the carpal region of the tentacle and well down its stalk. Funnel locking cartilages simple linear grooves and ridges. Gladius simple, loliginiform, with broad wings. Photogenic organs of very characteristic structure plentifully developed over almost the entire outer surface of the mantle, head, and arms.

Histioteuthid species (young).

Ommastrephid (young) Berry 1909 (pars), p. 419 (mere locality record).

Body small, ovate, considerably over half as broad as long. Fins very small, subterminal, and decidedly dorsal in position, with a nearly circular outline; practically continuous posteriorly. Anterior margin of mantle obtusely angled in the median line above; slightly emarginate below the funnel.

Head about half as large as the body; flattened above and below. Eyes rounded, prominent; their apertures small, angled in front but otherwise entire. Funnel rather large, little projecting. Mantle connectives a pair of simple grooves with thickened and reflexed margins at the base of the funnel articulating with narrow linear ridges on the inner surface of the mantle.

Arms over half as long as the mantle; rather stout; unequal, the order of length 2, 3, 1, 4. Suckers minute, spherical, biserial; horney rings well developed.

Tentacles but little longer than the arms. Club slightly expanded and armed with four rows of minute crowded suckers, the two outermost of which continue down the stalk nearly to its base.

Color in alcohol a dull brownish buff. The chromatophores are large, slate colored, thickly distributed above, but not without certain hints of a symmetrical arrangement in seven to eight more or less obscure transverse rows; much paler and less crowded below. Pigmentation on dorsal surface of head extremely dense. A single series of large chromatophores extends along the outer surfaces of all the arms, dark in color on the dorsal pair, but so pale as to be scarcely visible below. There are two distinct chromatophores placed opposite one another on the ventral aspect of the funnel not far from the middle.

Total length of largest specimen, 11 mm.; of mantle, 5 mm.; of head, 2.5 mm.; of arm of second pair, 3 mm.; of tentacle, 3.5 mm.; width of mantle, 3 mm. Length of smallest specimen, 9 mm.; of mantle, 4 mm.

Three specimens of this curious larval form were taken by the *Albatross* in the surface net at station 4190, latitude 34° 39′ 18″ N., longitude 132° 04′ W. [S. S. B. 254].

Although minute and offering no very conspicuous characters of their own, the above specimens undoubtedly represent larval stages of some Histioteuthid, perhaps *Calliteuthis* or some nearly related form. Although in all essential features they resemble the young Histioteuthid described by Pfeffer in Hoyle 1907, p. 1–2, sufficient minor differences are evident to render it probable that they belong to another species, even if referable to the same genus. From the young Ommastrephids with which they were at first confounded, the strong pigmentation, larger head, and longer arms are sufficient for their ready separation.

Family BRACHIOTEUTHIDÆ Pfeffer 1908.

Tracheloteuthidæ Pfeffer 1900, p. 152, 174.
Brachioteuthidæ Pfeffer 1908, p. 62, 78.
Tracheloteuthidæ Chun 1910, p. 205.
Brachioteuthidæ Pfeffer 1912, p. 345.

Body slender, loliginiform. Fins large, rhombic. None of the suckers on either arms or tentacles transformed to hooks; arms with two rows of suckers; tentacles with four or more rows. No fixing apparatus. Funnel locking cartilages simple and linear. Gladius slender, consisting for the most part of little but the rhachis; terminating in a long pointed cone.

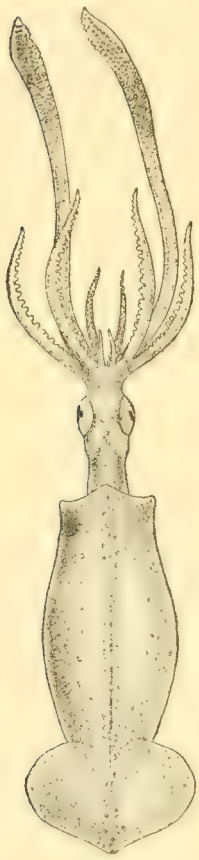

FIG. 37.—*Brachioteuthis* (*Trachelateuthis*) *riisei*, dorsal view of specimen [280], from station 3878, × 2. Drawn by R. L. Hudson.

Genus BRACHIOTEUTHIS Verrill 1881.

Brachioteuthis Verrill 1881, p. 405.
Brachioteuthis Pfeffer 1900, p. 174, 176.
Brachioteuthis Chun 1910, p. 206.
Brachioteuthis Pfeffer 1912, p. 346.

Characters af genus identical with those of the family, for the latter becomes monogeneric upon the union of *Tracheloteuthis* with *Brachioteuthis*, as is now very generally advocated.

Type.—*Brachioteuthis Beanii* Verrill 1881 (designation); a species of the New England region.

Subgenus TRACHELOTEUTHIS Steenstrup 1882.

Tracheloteuthis Steenstrup 1882, p. 294.
Verrilliola Pfeffer 1884, p. 22.
Entomopsis de Rochebrune 1884, p. 15.
Tracheloteuthis Hoyle 1886, p. 163.
Tracheloteuthis Pfeffer 1900, p. 174, 175.
Tracheloteuthis Pfeffer 1908, p. 78.
Brachioteuthis (pars) Chun 1910, p. 206.
Brachioteuthis (*Tracheloteuthis*) Pfeffer 1912, p. 355.

Mantle very thin, membranous. Entire animal nearly colorless except for a few chromatophores on the head and a very few scattered ones on the body. Fins large, rhombic, but never as long as half the mantle length.

Type.—*Tracheloteuthis Riisei* Steenstrup 1882 (species first mentioned); a species of almost cosmopolitan distribution.

Brachioteuthis (Tracheloteuthis) riisei (Steenstrup 1882).

Tracheloteuthis Riisei Steenstrup 1882 p. 294.
Tracheloteuthis Behnii Steenstrup 1882, p. 294.
Tracheloteuthis riisei Hoyle 1886, p. 36, 164, 213, 221, pl. 28, fig. 6–12.
Tracheloteuthis Behnii Weiss 1888, p. 85, pl. 10, fig. 1–4.
Tracheloteuthis riisei Lönnberg 1897, p. 603 (account of funnel organ).
Tracheloteuthis riisei Pfeffer 1900, p. 175.
Tracheloteuthis Riisei Hoyle 1905a, p. 93, pl. 14, fig. 1–5.
Tracheloteuthis riisei Pfeffer 1908, p. 79, fig. 93–95.
Tracheloteuthis Riisei Massy 1909, p. 30.
Tracheloteuthis riisei Berry 1909, p. 419 (mere locality record).
Brachioteuthis Riisei Chun 1910, p. 207.
Brachioteuthis (*Tracheloteuthis*) *Riisei* Pfeffer 1912, p. 355, pl. 26, fig. 1–20; pl. 27, fig. 1–9.

Animal small, pelagic, hyaline, extremely slender and graceful. Mantle very thin, inflated, elongate-cylindrical; swollen at the middle and tapering to an acute slightly attenuate point posteriorly; pallial chamber capacious, very scantily occupied by the delicate viscera. Mantle opening very wide, due largely to the extreme length and narrowness of the neck; anterior margin sharply angled in the medio-dorsal line, the ventro-lateral projections also well marked but somewhat less pronounced.

Fins fairly large, a little over one-fourth as long as the mantle; each one taken singly, a little longer than broad; barely separated in the medio-dorsal line by the narrow membrane covering the slender gladius, which extends past them as an acute point.

Head small, flattened, elongate, distinctly wider than the stalklike neck. Eyes large, little projecting; their apertures ample, with a slight obtuse anterior sinus. Funnel large, thin-walled, only its tip protruding beyond the mantle margin; valve minute. Funicular locking cartilages simple, with nearly straight grooves.

Arms conspicuously unequal, their order of length 2, 3, 4, 1; the lateral arms not only immensely longer than those of the dorsal and ventral pairs, but also more robust in every way; dorsal arms exceedingly short and weak, slightly recurved; the length of the second arms is about 5 to 6 times that of the dorsals, the third arms about 4½ times, and the ventrals 2½ to 3½ times; lateral arms usually a little more than half as long as the body, exceedingly slender and graceful, with a delicate narrow membrane or keel along their outward aspect. Suckers small, not crowded; pedicels conical; horny rings toothed.

Tentacles more robust, thicker, and much longer than any of the arms, attaining approximately twice the length of the second pair. Club little expanded; distal portion tapering and with a conspicuous dorsal keel; at this region the inner face of the club bears four rows of minute suckers (horny rings toothed), which increase regularly in size from the dorsal to the ventral row, the latter suckers long pediceled and with a diameter about three times that of the dorsal ones; distally all the acetabula regularly diminish in proportion, but proximally to this region those of the dorsal row about maintain their size, the remaining rows diminishing in size but greatly increasing in number so that we henceforth find at least eight closely crowded series of minute subequal suckers extending for perhaps a third the length of the tentacle, after which they again thin out; two of the rows continue down the stalk in distantly placed alternating series for another third of its length.

Gladius long, slender, consisting chiefly of the rhachis, and terminating in a delicate hollow cone; midrib visible through the dorsal integument as a narrow horn-colored line.

Color in alcohol everywhere a very pale brownish buff, the head and eyes darker; head brown, eyes with a slaty tone. Chromatophores sparse, pale, indistinct; a longitudinally-arranged series extends along the dorsal aspect of the mantle on either side of the gladius.

MEASUREMENTS OF TRACHELOTEUTHIS RISEI.

Number in author's register	280	280	280	280	280	280	280
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Total length	60	59	58	58	55	55	45
Length, excluding tentacles	46	45	46	45	41	41	33
Tip of body to base of dorsal arms	32	31	32	31	31	30	26
Length of mantle, dorsal	25	24	25	23	23	23	17
Extreme length of fins	6.5	6.5	7	6	6	5.5	3
Width across fins	10	10	11	10	9.5	8.5	7
Width of mantle	7.5	6	7.5	7	7	7	6
Width of head	2.5	2.5	3	2.5	2.5	2.5	2
Length of—							
Head	4	3.5	4.5	3.5	3.5	4	3
Dorsal arm	3	2.5	2.5	2.5	2	2	1.5
Second arm	15	14	14	13	12	11	7
Third arm	11	11	12	11	9	9.5	6
Ventral arm	7	7	7	8	7	5	3
Tentacle	27	25	28	27	24	24	21

Type.—In the Copenhagen Museum.

Type locality.—Latitude 34° 40′ S., longitude 7° W. (*fide* Hoyle).

Distribution.—North Atlantic (Lönnberg); off coast of Ireland (Hoyle, Massy); Faeroe Channel (Fowler); Messina, Sicily (Weiss, Hoyle); Gulf of Naples (Jatta); coast of Morocco (Joubin); St. Paul Island (de Rochebrune); Zanzibar (Pfeffer); Indian Ocean (Hoyle); west coast of New Guinea (Hoyle); Solomon Islands (Pfeffer); Hawaiian Islands (*Albatross*); between Honolulu and San Francisco, California (*Albatross*); Chile (Pfeffer).

SPECIMENS OF TRACHELOTEUTHIS RISEI EXAMINED.

No. of specimens.	Locality.	Depth.	Collector.	Author's register.
7	South of Lanai	Surface	Albatross station 3878	280
1	34° 39′ 18″ N. lat., 132° 04′ W. long	do	Albatross station 4190	281

Remarks.—These specimens, all of which are of approximately the same size and developmental stage as the one selected for figuring, are of interest here chiefly because they serve to extend the known range of this curious pelagic species over a much greater area of ocean it was previously reported to inhabit. There is small doubt that it will eventually prove to have an almost universal dispersion in the warmer currents of the ocean.

Family OMMASTREPHIDÆ Gill 1871.

Ommastrephini Steenstrup 1861, (*fide* Hoyle).
Ommastrephidæ Gill 1871, p. 1.
Ommastrephidæ Verrill 1881, p. 428.
Ommastrephini Hoyle 1886, p. 32, 162.
Ommatosrephidæ Pfeffer 1900, p. 153, 176.
Ommatostrephidæ Pfeffer 1908, p. 62, 87.
Ommatostrephidæ Pfeffer 1912, p. 369.

Animal usually of moderate size, but often of considerable dimensions; loliginiform. Fins large, sagittate, subterminal. Suckers in two rows on the arms, usually four rows on the clubs of the tentacles; none of the suckers modified into hooks. Fixing apparatus a single series of modified suckers and pads at the base of the club. Funicular cartilages highly developed, complex; their major outlines ⊥-shaped. Gladius consisting of little but the rhachis throughout the greater portion of its length; terminating posteriorly in a deep hollow cone. The occurrence of photogenic organs has not been described in any of the genera except *Hyaloteuthis*.

Genus OMMASTREPHES d'Orbigny 1835.

Ommastrephes d'Orbigny 1835, p. 45.
Ommastrephes d'Orbigny 1845, p. 412.
Ommatostrephes Lovén 1846 (*fide* Hoyle).
Ommastrephes (pars) Verrill 1880a–1881, p. 267, 385.
Todarodes Steenstrup 1880, p. 83 (13).
Ommatostrephes Pfeffer 1900, p. 178, 179.
Ommastrephes Hoyle 1902, p. 198.
Ommatostrephes Pfeffer 1908, p. 89, 92.
Ommatostrephes Pfeffer 1912, p. 388, 438.

Funnel groove with a foveola. Horny rings of large tentacular suckers with the teeth either nearly subequal, or with one or more of the apical denticles somewhat enlarged. Fixing apparatus very poorly developed. Sucker bearing portion of tentacle extending for more than half the total length.

Type.—*Loligo sagittata* Lamarck 1799 (species first mentioned); a common Atlantic species.

Ommastrephes hawaiiensis Berry 1912. (Pl. LIV, fig. 2.)

?*Ommastrephes sloanei* Schauinsland 1899, p. 92 (listed from Laysan Island).
Ommastrephes sagittata near *sloanei* Berry 1909, p. 418 (mere locality records).
?*Ommatostrephes Sloanei Sloanei* (pars) Pfeffer 1912, p. 458.
Ommastrephes hawaiiensis Berry 1912b, p 434, 437.

Animal loliginiform, moderate in size. Mantle cylindro-conical, widest somewhat in advance of the middle, thence tapering very rapidly to an acute point between the fins; margin smooth and entire above, slightly emarginate below the funnel. Fins only moderately large, triangular when taken

singly, together broadly sagittate; posterior outlines nearly straight, anterior ones arcuate and lobed at the inner margin; total length a little less than two-fifths that of the mantle.

Head large, a little broader than the body; flattened above and below; bounded posteriorly by raised thickened fleshy ridge, which is continuous with the three ear-like folds behind the eye composing the so-called olfactory crest. Eyes large, the large lid apertures with a small indented sinus in front.

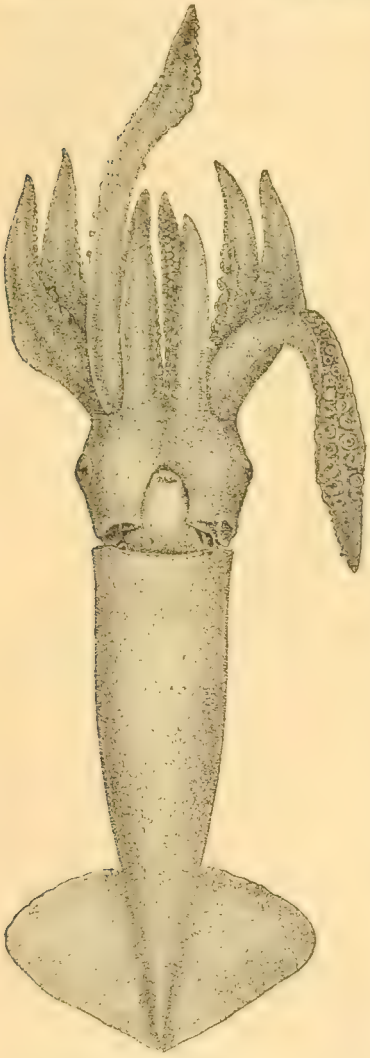

FIG. 38.—*Ommastrephes hawaiiensis*, ventral view of type [243]. × ½. Drawn by R. L. Hudson.

Arms moderate, stout, squarish, little attenuate, their average length about half that of the mantle; order of length in general 2, 3, 1, 4, or in younger specimens 2, 3, 1=4; not webbed at the base, but all strongly keeled along the outer angle, and with a narrow trabeculated membrane bordering the margins of the sucker-bearing area; the latter attaining its maximum along the ventral margins of the third arms, but scarcely developed on the ventral pair. Suckers large, distant; regularly alternating in two series so closely appressed together that they have rather the appearance of a single zigzag row; those of the dorsal arms distinctly smaller than the others; those of the lateral pairs largest, some of those near the middle of the arm attaining a diameter almost as great as that of the arm itself; on the arms of the second pair only about 36 to 40 suckers in all can be readily counted. Horny rings of the larger suckers with 19 to 21 teeth, the upper median tooth conspicuously the largest and more regularly conical in shape than the others; those of the lower margin blunt and much reduced (obsolete in the smaller suckers), the remainder acutely pointed; an occasional very minute denticle may be interpolated among the teeth of the upper margin.

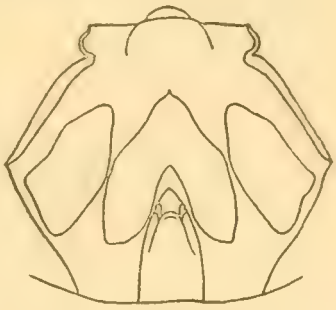

FIG. 39.—*Ommastrephes hawaiiensis* [242] outline drawing of funnel organ, natural size.

Tentacles stout, of moderate length, some two-thirds or more as long as the mantle; outer margin carinate; club slightly expanded, large, the sucker bearing area including 64 to 70 per cent of the total length of the tentacle. Suckers in four rows; all of small size at the extremity, the ventral row largest, thence very regularly decreasing in size dorsally; at the middle of the club the dorsal and ventral series about equal, but still very small and widely spaced, the suckers of the two median rows immensely larger (and therefore more crowded) and basin shaped, but proximally again showing a diminution in size; at the base of the club the central rows terminate, the marginal series continuing past them for a short distance down the stalk. The horny rings of the large median suckers are toothed all round, the 13 to 16 acutely-pointed curved teeth occurring in regular alternation with an equal number of wide, low, very thin arcuate plates; upper median tooth much larger and more pointed than the others, very much as already noted in the case of the suckers of the sessile arms. The small marginal suckers are much

deeper above and bear about 20 teeth, which are very long, slender and acute on the upper margin (obtuse and reduced below) and occur in alternation with minute bluntish denticles; none of the teeth in these suckers notably larger than the others. I can not make out any pads or specially differentiated suckers which could be construed as constituting a fixing apparatus.

Color in alcohol the usual brownish buff dotted with brown chromatophores.

MEASUREMENTS OF OMMASTREPHES HAWAIIENSIS.

Number in author's register	242	243 (type)	244	245	248
	mm.	*mm.*	*mm.*	*mm.*	*mm.*
Total length	285	282	195	151	207
Tip of body to tip of arms	249	239	179	131	172
Length of mantle, dorsal	147	138	107	81	105
Width of mantle near middle	31	33	23	21	22
Width across fins	76	76	54	42	.....
Extreme length of fins	56	52	37	27	....
Length of fins at base	50	45.5	33	22	.....
Length of head	35	28	22	18	18
Width of head	50	37	25	22	23
Length of—					
Right dorsal arm	60	62	41	26	35
Right second arm	76	77	50	33	42
Right third arm	78	76	48	32	50
Right ventral arm	58	60	41	26	41
Right tentacle	118	118	67	48	80
Sucker-bearing portion of right tentacle	81	80	43	32	43?
Left tentacle	.....	119	66	50	74
Sucker-bearing portion of left tentacle	.....	81	44	35	43?

Type.—Catalogue no. 214382, United States National Museum [S. S. B. 243].

Type locality.—*Albatross* station 4177, 253 to 282 fathoms, off Kahuku Point, northwest coast of Oahu, bottom of coral sand and foraminifera, July 25, 1902; one specimen.

Distribution.—Hawaiian and Midway Islands (*Albatross*).

SPECIMENS OF OMMASTREPHES HAWAIIENSIS EXAMINED.

No. of specimens.	Locality.	Depth in fathoms.	Collector.	Remarks.	Author's register.
1	Honolulu	.....	Albatross expedition	Young; badly desiccated	247
1	Honolulu market	.....	do	.....	383
1	Pailolo Channel	256–283	Albatross station 3865	.....	242
1	Off Kahuku Point, Oahu	253–282	Albatross station 4117	Type; U. S Nat. Mus., Cat. 214382.	243
1	Off Hanamaulu, Kauai	257–312	Albatross staion 4132	.....	244
1	Off Puniawa Point, Maui	220–238	Albatross station 4082	.....	245
1	Laysan Island	.....	Albatross hydrographic station 4353.	From stomach of *Sula piscator*.	248

Remarks.—This is one of the commonest Hawaiian squids and probably a species of considerable economic value in its food relations to many sea birds and the larger fishes. Because it is so abundant and characteristic a member of the fauna of this region, I have little doubt that the specimens listed by Schauinsland and more recently Pfeffer from Laysan Island as *O. sloanei* are the same form. The true *O. sloanei*, however, appears to be a somewhat different creature, as Gray expressly states that the horny rings of the suckers have the "higher side with *regular* acute teeth, lower *smooth*" (italics mine), while the remainder of Gray's diagnosis is so sadly incomplete or even silent regarding what should prove to be features of the highest importance, that there seems every likelihood that other even more striking differences will eventually appear. *O. hawaiiensis* is undeniably a near relative of the Japanese *O. pacificus* Steenstrup, considered by many to be a synonym of *O. sloanei* (cf. Berry 1912b, p. 436–437), but the specimens before me differ consistently in their more rapidly tapering body, slightly shorter fins, much larger and wider head, very much fewer and larger suckers on the sessile arms (especially

the second and third pairs), and the fact that the teeth of the latter are not subequal but the middle tooth on the upper side is conspicuously larger than its neighbors, showing in this last character an approach to the condition prevailing in the Atlantic *O. sagittatus*. From this résumé it would appear that *O. hawaiiensis* is in some respects intermediate between *O. sagittatus* and *O. pacificus*, while in a few particulars it is somewhat different from either.

The position of *O. sloanei* I am now disposed to regard as more doubtful than ever, for undoubtedly the union of *O. pacificus* with it was more premature than the meager evidence would justify. The habitats of all three of the Pacific forms are still widely separated, and further material, particularly from southern localities, is an important desideratum.

Genus SYMPLECTOTEUTHIS Pfeffer 1900.

Symplectoteuthis Pfeffer 1900, p. 178, 180.
Symplectoteuthis Pfeffer 1912, p. 388, 501.

Funnel groove with a foveola. Funicular locking cartilages fused with those of mantle on at least one side. Horny rings of large tentacular suckers with one tooth in each quadrant much enlarged. Sucker-bearing portion of tentacle comprising less than half the total length. Fixing apparatus composed of a few heavy pads and smooth-ringed suckers.

Type.—*Loligo oualaniensis* Lesson 1830 (monotypic); a species of the tropical Pacific.

Symplectoteuthis oualaniensis (Lesson 1830) Pfeffer 1900.

Loligo oualaniensis Lesson 1830, p. 240, pl. 1, fig. 2.
Ommastrephes oualaniensis d'Orbigny 1845, p. 427.
Ommastrephes oualaniensis Tryon 1879, p. 180, pl. 81, fig. 368 (after d'Orbigny).
Ommastrephes oualaniensis Schauinsland 1899, p. 92 (listed from Laysan).
Symplectoteuthis oualaniensis Pfeffer 1900, p. 180.
Symplectoteuthis oualaniensis Hoyle 1904, p. 32, fig. F.
Symplectoteuthis oualaniensis Berry 1909, p. 419 (merely listed).
Symplectoteuthis oualaniensis Pfeffer 1912, p. 502, pl. 40, 41; pl. 42, fig. 1–4.

I have seen no specimens of this species, but include it here on the authority of Schauinsland, who found it one of three species of squid which compose a chief food for the Laysan albatross. It is an abundant species of wide distribution, having been reported from the Red Sea, Laccadive Islands, Japan, Australia, the Cocos Islands, and Laysan. It may be readily recognized by the compressed arms, short tentacle club, and the fusion of the ventral mantle locking cartilages with those of the funnel.

Genus RHYNCOTEUTHION Pfeffer 1908.

Rhyncoteuthis Chun 1903, p. 716 (not of d'Orbigny 1847).
Rhyncoteuthis Hoyle 1904, p. 32.
Rhyncoteuthion Pfeffer 1908, p. 88.
Rhyncoteuthis Chun 1910, p. 201.

This is a name which has been applied to various larval *Ommastrephidæ* during the curious stage when the tentacles are fused along a portion of their inner faces, to form in some cases an elongate proboscis-like organ, or in others a pincer-shaped organ. The development and relationships of the different forms which have been described is still so insufficiently known that it is impossible to refer them to the proper adult form, so that it is convenient to give them provisional consideration by themselves.

Type.—No type has ever been given and but one species (*R. chuni* Hoyle 1904) has received a specific name.

Rhyncoteuthion α. (Pl. LIII, fig. 1.)

Cf. *Rhyncoteuthis chuni* Hoyle 1904, p. 32, fig. G.
Ommastrephid (young) Berry 1909 (pars), p. 419 (mere locality records).

Animal small, pelagic. Body rather short, robust, cylindrical, tapering to a blunt point posteriorly; width of mantle in largest specimens less than half its length, in smaller examples considerably more than half its length. Fins extremely short and broad in the larger specimens (mantle length of 20 mm.), more rounded and very minute in the smaller, with all variations between; subterminal to terminal. Locking cartilages typically Ommastrephid.

Head short, broad, flattened, averaging about the same width as the mantle. Eyes large and in all but the largest specimens prominently protruding; lid openings with a small sinus in front.

Arms very short and stout; second and third pairs longest, ventrals shortest, a condition especially apparent in the more minute specimens; lateral arms (especially the third pair) outwardly keeled, but true umbrella wanting. Suckers minute, spherical, in two series.

Tentacles but little longer than the arms, but their appearance very variable. In the smallest specimen seen (mantle length of 5 mm.) they are slender, fused along their inner faces for the greater portion of their length, but free at the extreme base and at the extremities, which bear a few suckers (3 to 4 each), one of the latter being so conspicuously larger than the remainder as to be barely visible to the unaided eye. In slightly larger specimens (mantle length of 6.5 to 7 mm.) the tentacles are more completely separated but are yet fused for a short diatance near the base of the small recurved pointed club (this is the condition typical of Hoyle's *R. chuni*), and minute swellings, the rudiments of future suckers, are now visible on the club distal to the large sucker and group of smaller ones mentioned above. Soon after this (mantle length of 9 mm.) the tentacles become entirely free of one another, though still bent strongly inward and with the tips still recurved. Further development is now rapid and the largest specimens show four longitudinal series of extremely minute suckers, those of the two outer rows much smaller than the central ones and already extending down onto the short robust stalk. The four carpal suckers are still separately distinguishable, but are now no larger than the median ones farther distad.

Color in alcohol a pale brownish buff, the chromatophores brown. The latter show a very constant disposition, forming (1) a broad transverse girdle around the middle of the body, shading paler at its anterior and posterior margins, and (2) an irregular dotting over the dorsal surface of the head, with a tendency to concentrate into two dark roundish spots, one over either eye.

MEASUREMENTS OF RHYNCOTEUTHION *α*.

Number in author's register	255	255	253	Number in author's register	255	255	253
	mm.	*mm.*	*mm.*	Length of—Continued.	*mm.*	*mm.*	*mm.*
Total length	35	23	11	Dorsal arms	7	5.5	2
Length of mantle, dorsal	21.5	15	6	Second arms	8+	6.5	2+
Length of fins	4.5	3	1.5	Third arms	8—	6	2—
Width across fins	11.5	8.5	3	Ventral arms	6	4	1
Width of mantle	9	7.5	5	Tentacles	10	7	.....
Width of head	9.5	8	4	Sucker bearing portion of tentacles	6.5	5	.....
Length of—							
Head	5	4	2				

SPECIMENS OF RHYNCOTEUTHION *α* EXAMINED.

No. of specimens.	Locality.	Depth.	Collector.	Remarks.	Author's register.
2	Off Mokapu Islet, Molokai	Surface	Albatross station 3889	Tentacles of 1 fused; others free.	249
1	Off Diamond Head, Oahu	do	Albatross station 3912	Tentacles free	250
5	Between Honolulu and Laysan	do	Albatross station 3926	do	255
1	Between Oahu and Kauai	do	Albatross station 3980	do	251
1	do	do	Albatross station 4010	Tentacles fused	252
1	Off Modu Manu	do	Albatross station 4152	do	253

Remarks.—This is a very interesting series and very beautifully shows the ontogenetic transition from the small larva with proboscidiform tentacles similar to that originally figured by Chun to the normal juvenile stage with free tentacles. Originally fused throughout practically their entire length, these organs begin to separate at the base as growth ensues, and then gradually split apart, the carpal region of the clubs marking the point of most persistent adhesion. Microscopical preparations show that the integument is truly continuous at the area of junction and that therefore the union is not merely a mechanical one.

Individuals of the corresponding stage in the degree of separation of the tentacles approximate very closely to the brief account and figure of *R. chuni* as given by Hoyle, and may very well be congeneric with it, although only the identification of the adults will show whether they are referable to the same species. The fact that the suckers extend more than half way along the tentacles of the largest specimen affords a certain suggestion that the present series are larval *Ommastrephes hawaiiensis*.

Rhyncoteuthion β.

Animal small, pelagic; mantle elongate, less than half as wide as long; nearly cylindrical, slightly tapering, bluntly pointed posteriorly. Fins almost continuous above, minute, rounded, subterminal. Anterior margin of mantle with a faint medio-dorsal angle; very weakly emarginate below the funnel. Locking appartus typically Ommastrephid.

Head small, flattened; a little wider than the body. Eyes large, rounded; apertures angled in front. Funnel short, broad, not reaching to the eye openings.

Arms very short, unequal, the ventral pair decidedly the shortest; suckers moderately large, biserial, obliquely placed on short pedicels; horny rings minutely toothed.

Tentacles shorter than the arms, and remarkable in that their inner faces are fused with one another for only a short space below the free recurved tips. When examined with a high-power lens each tentacle is seen to be furnished with a number of small suckers just distal to the point of fusion, one of which is greatly larger than the others, hood shaped, distinctly pediceled, its horny ring minutely toothed, median in position, and placed in close opposition to its mate of the other tentacle.

Color in alcohol a pale brownish buff, the chromatophores considerably darker. There is a pair of large rather conspicuous chromatophores transversely placed on the dorsal aspect of the head.

MEASUREMENTS OF RHYNCOTEUTHION β.

	mm.		*mm.*
Total length	12.5	Width across fins	3
Length of mantle, dorsal	8	Length of fins	1.5
Width of mantle	3	Length of second arms	2.5
Width of head	3.5	Length of tentacles	1.5
Length of head	2		

Material examined.—The single specimen was taken from the surface *Albatross* station 3930, latitude 25° 07′ N., longitude 170° 50′ W., between Honolulu and Laysan Island (S. S. B. 246).

Remarks.—The unique specimen forming the subject of the foregoing account is a minute squid at once distinguishable from the preceding by its elongate more pointed body and entirely different arrangement of the chromatophores. The curious pair of large opposite suckers on the tentacles may merely represent the first of these structures to become fully differentiated, but their entire aspect is rather that of some temporary larval adaptation.

Family CHIROTEUTHIDÆ Gray 1849.

Chiroteuthidæ Gray 1849, p. 36, 42.
Chiroteuthidæ Verrill 1881, p. 430.
Chiroteuthidæ Pfeffer 1900, p. 153, 183.
Chiroteuthidæ Chun 1910, p. 216.
Chiroteuthidæ Pfeffer 1912, 539.

Body soft and semigelatinous or somewhat membranous. Mantle elongate, terminating in an acute and often slender point. Fins large. Head elongate; "olfactory tubercle" stalked. Arms with two rows of suckers, the ventral pair usually conspicuously the longest and largest. Tentacles very long, the stalk without suckers; club with four or more rows of suckers; none of the suckers on either arms or tentacles modified into hooks. Funicular locking cartilages broad, deeply grooved, usually more or less ear-shaped. Gladius slender, with weak narrow wings and a long cone. Photogenic organs may occur over the outer surface of the body, on the eyeball, or within the pallial chamber; frequently absent.

Subfamily MASTIGOTEUTHINÆ (Verrill 1881) Chun 1908.

Mastigoteuthidæ Verrill 1881a, p. 100.
Mastigoteuthinæ Chun 1908, p. 87.
Mastigoteuthinæ Chun 1910, p. 219, 220.
Mastigoteuthinæ Pfeffer 1912, p. 540, 608.

Olfactory tubercle or papilla short-stalked. Tentacles long and slender; club not expanded and without glandular swellings at tip. Photogenic organs in some cases numerously developed over the entire integument, sometimes lacking; no photophores upon the eyeball or within the pallial chamber.

Genus MASTIGOTEUTHIS Verrill 1881.

Mastigoteuthis Verrill 1881a, p. 100.
Mastigoteuthis Pfeffer 1900, p. 184, 187.
Mastigoteuthis Chun 1910, p. 220.
Mastigoteuthis Pfeffer 1912, p. 609.

The characters of this genus coincide with those of the subfamily of which it is the only known representative.

Type.—Mastigoteuthis Agassizii Verrill 1881 (monotypic); a North Atlantic species.

Mastigoteuthis (?) famelica (Berry 1909) Pfeffer 1912. (Pl. LII, fig. 6–8.)

Chiroteuthis famelica Berry 1909, pp. 414, 419, fig. 8.
Mastigoteuthis (?) famelica Pfeffer 1912, p. 624.

Animal small, graceful, its outlines attenuate. Mantle cylindrical, extremely long and narrow; gradually tapering for a little more than half its length, then becoming suddenly constricted to continue as an exceedingly slender and delicate spit extending between the fins and somewhat exceeding them posteriorly; anterior margin sinuous, inflated, projecting in an obtuse point in the medio-dorsal line. Fins enormous, leaflike, not lobed; at the base relatively thick and fleshy, but thin at the margins; each one about three times as long as wide and extending for a little more than half the length of the mantle; separated only by that portion of the slender posterior extension of the mantle which covers the delicate gladius; in front the attached margins extend well forward on the dorso-lateral surfaces of the main body.

Head small, narrower than the body except across the eyes, whence it rapidly tapers to the narrow elongate neck (the neck is rather longer than wide); dorsal and ventral surfaces flattened. Eyes large, rounded, conspicuous, somewhat protruding; very anterior in position. "Olfactory papilla" short, but possibly not well represented in the present specimen. Funnel small, broadly conical, not quite reaching to the eyes. Funicular locking cartilages deep, ear-shaped, with ridges to correspond on the inner surface of the mantle.

Arms, except the ventrals, extremely short in proportion to the length of the body; decidedly unequal, the order of relative length being 4, 2, 3, 1. Ventral arms enormously developed, about three times as long as the others and half as long as the body; squarish; sucker-bearing surface very narrow in proportion to the total diameter of the arm and furnished with two alternating rows of distant minute slender pediceled suckers, the horny rings of the latter minutely toothed. Remaining arms more nearly of a length, the dorsal pair a little the shortest and weakest; their suckers slightly larger and more crowded. All the arms obscurely keeled. Umbrella and lateral membranes wanting.

Tentacles missing.

Gladius extremely long and slender, the posterior cone terminating in a long needle-like point; visible through the dorsal integument as a dark medio-longitudinal line.

Color in alcohol a pale brownish buff; chromatophores brown but very sparsely distributed. Such portions of the outer integument as remain intact are devoid of photogenic organs, and I have not succeeded in identifying any of these structures upon the eyeball.

MEASUREMENTS OF MASTIGOTEUTHIS (?) FAMELICA.

	mm.		mm.
Tip of body to tip of ventral arms	64	Width of head	4
Tip of body to base of dorsal arm	44	Length of—	
Tip of body to medio-dorsal margin of mantle	39	Head	5
Extreme length of fins	21	Dorsal arm	5
Length of fins at base	21	Second arm	6.5
Width across fins	14.5	Third arm	5.5
Width of mantle	4	Ventral arm	20

Type.—Catalogue no. 214314, United States National Museum [S. S. B. 260].

Type locality.—*Albatross* station 3989, 385 to 733 fathoms, bottom of coral sand and rock, vicinity of Kauai Island, June 11, 1902; a single specimen.

Material examined.—The type is unfortunately unique.

Remarks.—Although the whole aspect of this species is suggestive of *Chiroteuthis* rather than *Mastigoteuthis*, the short olfactory papilla and the apparent absence of photophores on either the eyes or the ventral arms preclude its reference to that genus as I had originally placed it. On the other hand, it seems to have little in common with the remarkable *M. agassizii* Verrill, which is the type species of the latter genus. Verrill's species is notable for the extremely rich development of photogenic organs over the entire outer integument, and possesses other features which induce me to believe that it will eventually prove generically distinct from almost all the more recently described species usually associated with it. Even from the latter forms the present species is strikingly different, and as the condition of the single specimen is confessedly not all that might be desired, besides being very likely immature, it may be that better material may after all accomplish its restoration to *Chiroteuthis*.

In purely superficial characters *M. famelica* seems nearer to *C. pellucida* Goodrich of the Bay of Bengal than to any other form of either genus known to me, but differs in the much larger fins, shorter neck, more poorly developed arms, and a number of other characters. Both species are remarkable for their gaunt slender body, and to this feature is due the specific name of the Hawaiian form.

Family CRANCHIIDÆ (Prosch 1847).

Cranchidæ Prosch 1847, p. 19.
Cranchiadæ Gray 1849, p. 37.
Cranchiaeformes Steenstrup 1861 (*fide* Hoyle).
Desmoteuthidæ Verrill 1881, p. 300.
Cranchiidæ P. Fischer 1882, p. 340.
Cranchiidæ Pfeffer 1900, p. 154, 188.
Cranchiidæ Chun 1906, p. 82.
Cranchiidæ Pfeffer 1908, p. 63, 101.
Cranchiidæ Chun 1910, p. 299.
Cranchiidæ Pfeffer 1912, p. 636.

Mantle border firmly fused with the head in the nuchal region and with the base of the funnel on either side. Body usually membranous and transparent; nearly colorless. Eyes usually large, often pedunculate. Sessile arms with two rows of suckers only; tentacles with four rows of suckers, which frequently extend down the stalk for the greater portion of its length; hooks may occur on the tentacle club, but only in one or two genera. Photogenic organs may be numerously developed on the ventral aspect of the eyeball, may occur within the pallial chamber, or may be entirely absent.

Genus LIOCRANCHIA Pfeffer 1884.

Liocranchia Pfeffer 1884, p. 25.
Liocranchia Chun 1906, p. 84.
Liocranchia Chun 1910, p. 303, etc.
Liocranchia Pfeffer 1912, p. 644, 665.

Mantle thin, saccular; often much inflated. Fins of rounded outline, terminal, small to moderate in size. Two diverging series of small conical cartilaginous tubercles extend back from the ventral point of fusion of the mantle and funnel on either side; in some forms a similar series may be present

along the medio-dorsal line of the mantle. Eyes large, sessile; a row of four large oval photophores on the ventral aspect. Left ventral arm hectocotylized.

Type.—*Liocranchia Brockii* Pfeffer 1884 (species first named)=*L. reinhardtii* (Steenstrup), a species of very wide distribution.

Liocranchia globulus Berry 1909. (Pl. LIII, fig. 2–4.)

Cranchia (*Liocranchia*) *globula* Berry 1909, p. 415, 419, fig. 9.
Liocranchia reinhardtii (pars) Chun 1910, p. 336, 337.
Liocranchia globulus Pfeffer 1912, p. 666, 674.

Animal small, pelagic. Body almost completely spherical; short, rounded, the maximum diameter almost but not quite equal to the length; mantle truncate in front, suddenly constricted posteriorly and tapering rapidly to an acute point which forms the base of attachment for the fins. Mantle mainly smooth; very thin and membranous; anterior margin passing in three even nearly equal curves from each point of attachment to the next; the latter three in number and about equidistant, the ventral points of fusion with the base of the funnel being about as far separated from one another as either is from the nuchal attachment. At the extreme mantle margin the position of each point of attachment is marked externally by a series of small projecting cartilaginous tubercles of acutely conical shape; the dorsal series is a close succession of at least 48 tubercles in single file, forming a narrow cartilaginous ridge along the anterior two-thirds of the medio-longitudinal line, a wedge-shaped area forming the posterior continuation of this ridge being hyaline and bare; the ventral series are each double, forming a Λ-shaped ridge having its apex at the margin, and with about 20 minute tubercles of two sizes in more or less irregular alternation in each line, flanked at the anterior end by parallel rows of two or three smaller tubercles on each side (pl. LIII, fig. 2). The divergence between the diverging arms of these ventral series is somewhat less than 90 degrees.

Fins small, thin; very short and broad, so that the outline of each is roughly circular; separated only by the minute posterior protrusion of the mantle, beyond which they extend for perhaps a third of their length; base of attachment only about one-half the total length.

Head minute; exceedingly short and broad; little projecting beyond the mantle. Eyes large, prominent; lid apertures very small, constricted; a series of four rather large oval photophores is visible on the inner ventral periphery upon the removal of the outer integument; they are subequal in size, very closely placed, and to all appearances essentially similar under a low power lens. A very large transparent fingerlike "olfactory papilla" has its origin from the outer integument just back of the eyelid opening. Funnel short, broad, well projecting beyond the mantle, and with a noticeable ventral flexion not far from the tip.

Arms short, poorly developed; unequal, the relative order of length 3, 4, 2, 1; dorsal pair decidedly the shortest and weakest, bearing only 6 to 8 pairs of suckers (largest near the base); second and fourth pairs more nearly equal, each second arm with about 9 pairs of suckers; third pair much the largest and longest, bearing 12 or more pairs of suckers. Umbrella present but poorly developed; extending between the dorsal arms for nearly half their length, and not exceeding this width between any of the arms; apparently absent between the arms of the ventral pair, and nearly so between these and the third pair. Suckers exceedingly minute, pedunculate; in two regularly alternating rows; horny rings apparently smooth, but this feature is somewhat difficult to ascertain.

Tentacles stout, smoothly cylindrical, much thicker and heavier than the arms; nearly as long as the mantle. Clubs little expanded, tapering to a bluntish point, lightly keeled, and furnished with a narrow delicate swimming membrane along each margin. Suckers minute, pedunculate; on the club in four rather crowded rows; largest near the middle of the club, very minute distally, and also proximally, where they gradually become more widely spaced, each row in the meanwhile tending to press in toward the center, so that there soon appear to be but two rows which continue down the stalk for about two-thirds of its entire length;[a] aperture of suckers small; horny rings apparently smooth, but surrounded by radial papillæ.

[a] In the smallest specimen these suckers extend practically to the base of the stalk.

Color of preserved specimens a semitranslucent grayish white, probably colorless or opalescent in life. Chromatophores light brown in color; few in number; minute; most evident are a number of very small ones scattered over the posterior portion of the ventral surface of the mantle in advance of the fins; there is also a transverse series forming a slightly irregular semicircle on the ventral aspect a little distance back of the mantle margin. Two longitudinal series of distantly placed chromatophores extend along each tentacle.

MEASUREMENTS OF LIOCRANCHIA GLOBULUS.

Number in author's register	262	282	Number in author's register	262	282
	mm.	*mm.*		*mm.*	*mm.*
Total length (mantle distended)	45	22	Width across fins	7	4
Tip of body to tip of third arms (mantle distended)	26	14	Width of head	4.5	.....
Dorsal length of mantle, exclusive of fins (distended)	20	11	Length of—		
Dorsal length of mantle, exclusive of fins (not distended)	25	.....	Head	2	.....
Maximum width of mantle (distended)	19	10	Dorsal arms	1	.....
Extreme length of fins	4	2	Second arms	1.5	.....
Length of fins at base	2	.....	Third arms	3	.....
			Ventral arms	2	.....
			Tentacle	19	9
			Tentacle club	4	.....

Type.—Catalogue No. 214315, United States National Museum [S. S. B. 262].

Type locality.—*Albatross* station 3878, surface, south of Lanai and west of Kahoolawe, April 14, 1902; two specimens.

Distribution.—Hawaiian Islands (*Albatross*).

SPECIMENS OF LIOCRANCHIA GLOBULUS EXAMINED.

Number of specimens.	Locality.	Depth.	Collector.	Remarks.	Author's register.
1	Off Molokini Islet, south of Lanai and west of Kahoolawe.	Surface	Albatross station 3878	U. S. Nat. Mus., Cat. 214315; type.	262
1	do	do	do	Cotype	282
1	Between Kauai and Oahu	do	Albatross station 4009		263

Remarks.—Should this curious form prove to be a valid species, it adds one further member to the very remarkable group of aberrant squids which comprise the family *Cranchiidæ*. The inflated saccular mantle here reaches practically the greatest attainable maximum of rotundity, so that a specimen looks not unlike a bubble having a few appendages of small size at either pole. The nearest ally of our species is self-evidently the *L. reinhardtii* (Steenstrup), with which indeed it is united by Chun, but the latter possesses the characteristic inflation only in vastly less degree. Lönnberg (1897, p. 611) has considered rotundity to be a condition in *L. reinhardtii* attendant upon immaturity and has given figures of an unusually large specimen which is almost loliginiform. However, the largest of the *Albatross* specimens is no whit less spherical than the youngest, and in this feature no figures or measurements of *L. reinhardtii* which I can find on record show close approach to any of them. On the other hand our knowledge of the limits of variation in these forms, either living or after preservation, is still very far from complete, and Chun's suggestion that this extreme state of inflation is due to a sharp contraction of the circular muscles around the mantle opening at the moment the animals were killed may prove to be the true explanation. Should this be so, it is somewhat curious that all three of the specimens before me chanced to be overwhelmed by the preserving fluid at exactly the same moment of contraction. It is believed that the drawings show the true condition with a very fair degree of accuracy, as in each case the mantle of the specimen was carefully distended by means of a pipette without the exertion of undue pressure, and an attempt was even made to keep the specimens so inflated suspended freely in the alcohol while the more important measurements were being taken.

In all other respects the Hawaiian form is essentially similar to *L. reinhardtii* except that (1) the number of cartilaginous tubercles in the dorsal series is somewhat less than given by Lönnberg for the specimen described by him, although more numerous in the ventral series; (2) the fins are conspicuously smaller; and (3) according to Pfeffer the statement that the latter are "flanked near the anterior end by parallel rows of two or three smaller tubercles on either side" does not hold with respect to the older species.

Genus MEGALOCRANCHIA Pfeffer 1884.

Megalocranchia Pfeffer 1884, p. 24.
Desmoteuthis Pfeffer 1900, p. 191 (not of Verrill 1881).
Desmoteuthis Chun 1906, p. 85.
Desmoteuthis Chun 1910, p. 304, 356.
Megalocranchia Pfeffer 1912, p. 645, 711.
Megalocranchia Berry 1912c, p. 644

Body cask-shaped, membranous, transparent, very weakly pigmented. Fins oval, longer than broad, overreaching the extremity of the body. Eyes large, rotund, protruding, sessile; on the ventral surface of each a very large semicircular photogenic organ, with a smaller crescent-shaped organ just in front. Arms with two rows of suckers; tentacles with four rows of suckers which extend along the greater portion of the stalk; none of the suckers modified into hooks; no fixing apparatus. Photogenic organs wanting except on the eye as stated.

Type.—*Megalocranchia maxima* Pfeffer 1884 (monotypic); described from the Cape of Good Hope.

Megalocranchia fisheri (Berry 1909) Pfeffer 1912. (Pl. LIII, fig. 5, 6; pl. LV, fig. 2.)

Helicocranchia fisheri Berry 1909, p. 417.
Xenoteuthis fisheri Berry 1909, p. 419 (error).
Megalocranchia fisheri Pfeffer 1912, p. 718.
Megalocranchia fisheri Berry 1912c, p. 644.

Animal small, body somewhat barrel-shaped. Mantle smooth, tough, membranous, saccular, thin, very much inflated; largest at a point nearly midway between the head and fins; somewhat tapering anteriorly and to a greater degree posteriorly, where it becomes at last suddenly constricted, terminating in a short, slender, spitlike point extending between the fins and serving as their base of attachment; maximum width of mantle probably about half its length.[a]

Fins rather small, thin; each semicircular, almost exactly half as wide as long, and a little over a quarter the length of the mantle; almost continuous posteriorly and separated along the median line only by the thread of integument covering the slender hinder extremity of the gladius.

Head very short and broad; slightly concave above and below; relatively very large, due to the enormous globular eyes which are only faintly constricted at the base; lid openings very small, puckered, so elevated as to appear almost papilliform. Mantle attached firmly to the head in the nuchal region and also to the base of the funnel on either side. Funnel large, thin-walled, conical, broad at the base; extremity not quite reaching the base of the ventral arms; aperture ample, with a caplike upper lip. Funnel organ difficult to distinguish with certainty.

Arms short, robust, fleshy, the longest less than one-third the length of the mantle; unequal, the order of length 3=4, 2, 1; umbrella wanting; all the arms outwardly keeled and provided with a very delicate trabeculated marginal membrane, which attains by far its best development on the arms of the third pair; the latter in every way larger than the others and with larger suckers. Suckers biserial, closely placed, regularly alternating to the tip; oblique, hood-shaped; apertures wide; horny rings (at least on third arms) scarcely dentate, but very minutely and beautifully crenulate on the upper border, nearly smooth below.

[a] The mantle is much wrinkled and contracted in this specimen, especially ventrally (where the distance from the tip of the body to the mantle margin is much less than it is dorsally), thus precluding the possibility of accurate measurement or exact statement of relative proportions. This condition is probably wholly due to the action of the preserving fluid.

Tentacles rather short, stout, about twice as long as the arms, as compared with which they are larger and heavier in every way; stalks nearly cylindrical. Clubs large, well expanded; bordered by a narrow frill-like web or keel along either margin of the sucker-bearing area, supplemented dorsally by a wider gracefully crenulate membrane which has its origin outside the former and lies parallel to it along the distal two-thirds of the club. Suckers small, in four distinct but rather crowded rows on the club; the two median series slightly the larger, but the suckers in all four rows attaining their maximum near the middle of the club; distally they gradually diminish in size, and also proximally, where they steadily become more widely spaced, extending down the flattened inner surface of the stalk for about half its length (exclusive of the club); the four-rowed condition really persists throughout, but on account of the tendency of the various series to press in toward the center at the same time with the increase in interspacing of the suckers, the arrangement soon appears to be biserial and maintains this appearance throughout most of the length of the stalk. Proximal to the point where the marginal membrane of the club comes to an end some 20 to 23 of these alternating pairs of suckers may be counted. Horny rings of the larger suckers minutely dentate on the upper margin with 12 to 14 sharp-curved elongate teeth, which become nearly or quite obsolete below.

Color of preserved specimen a soiled semitranslucent white. Chromatophores very minute and sparsely distributed; they apparently exhibit no very definite arrangement.

Two large photogenic organs form a conspicuous brownish patch nearly covering the ventral surface of each eyeball and visible even through the outer integument which overlies them. The larger is roughly semicircular in outline, its flatter anterior margin somewhat concave, and with the convex side of the crescent-shaped smaller organ closely applied within it. The outline of both organs is in the main similar to those of *D. pellucida* as figured by Chun, but considerably more elongate.

MEASUREMENTS OF MEGALOCRANCHIA FISHERI.

	mm.		*mm.*
Total length	73	Length of—	
Length of mantle (dorsal)	47	Right second arm	8
Maximum width of mantle	23	Left second arm	8
Extreme length of fins	12.5	Right third arm	13
Width across fins	12.5	Left third arm	12
Length of head (median)	4	Right ventral arm	12
Width of head across eyes	15	Left ventral arm	12.5
Length of—		Tentacle	27
Right dorsal arm	6	Sucker-bearing area of tentacle	18
Left dorsal arm	6	Tentacle club	8
		Funnel	8

Type.—Catalogue No. 214316, United States National Museum (S. S. B. 106).

Type locality.—*Albatross* station 3883, 277 to 284 fathoms, bottom of globigerina ooze, off Mokuhooniki Islet, Pailolo Channel, April 16, 1902; one specimen.

Distribution.—Hawaiian Islands (*Albatross*).

Material examined.—The type is unique.

Remarks.—This species is a typical *Megalocranchia*, showing exceedingly close affinity to both the *M. maxima* Pfeffer and the more recently described *M. pellucida* (Chun). The latter species is peculiar in that the horny rings of the tentacular suckers are bluntly toothed, lacking the long acute teeth which are characteristic of both the other species. The following rather trivial features distinguish *M. fisheri* from *M. maxima*: (1) The longer tentacles. (2) The longer ventral arms. In his description of *M. maxima* Pfeffer says regarding the arms that "4 und 2 sind wenig verschieden," while in the present species the disproportion between the arms of these pairs is conspicuous. In my first diagnosis I gave the arm formula as 4, 3, 2, 1. In reality this is true of the left side only, the right arms standing 3, 4, 2, 1, but in both cases the difference between the third and ventral arms is so slight as scarcely to be worth

mentioning, so that the formula is perhaps preferably stated as 3=4, 2, 1. (3) The horny rings of the tentacular suckers have 12 to 14 instead of 10 teeth on the upper margin. These are none of them very great differences, but seem sufficient, together with the widely separate habitats of the two forms, to render their union unjustifiable until a better representation of each is available for study.

My original reference of this species to *Helicocranchia* was certainly ill advised, our species differing conspicuously in the larger, more elongate nonpedunculate fins, spitlike posterior continuation of the mantle, much smaller funnel, and very much larger unstalked eyes.

The discovery of this species very greatly extends the known geographical range of the little group of typical *Megalocranchia*, but even yet the distribution of the various species is of interest because of the continuity of the respective regions occupied by them. Beginning with *M. pellucida* in the south Atlantic, the remaining species form a geographic chain extending more than halfway around the globe. *M. maxima* is known only from the Cape of Good Hope, *M. abyssicola* Goodrich from the waters of the Indian peninsula, and the present species from the Hawaiian Islands. Because of its occupancy of so distant and isolated a region, the Hawaiian species might be expected to be the most highly differentiated member of the group, but such is very far from being the case. On the other hand *M. abyssicola* seems in many ways peculiar and not so closely allied to any of the other three forms as they are to one another.

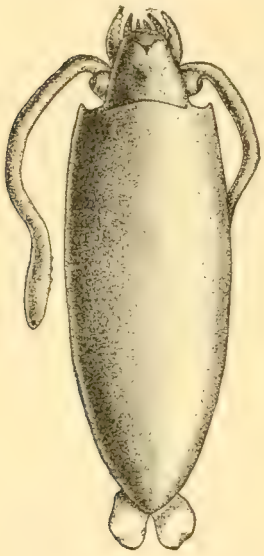

FIG. 40.—*Helicocranchia* sp., ventral view of specimen [261] from the vicinity of Kauai, partially restored. × 2. In this figure the mantle is scarcely represented as sufficiently elongate and the arms are probably shown as much too short and stocky.

It has been a pleasure to associate with this interesting species the name of my friend, Dr. Walter K. Fisher, who, as a member of the staff of the *Albatross* during the Hawaiian explorations, had no small part in the duties of caring for and preserving the present material.

Genus HELICOCRANCHIA Massy 1907.

Helicocranchia Massy 1907, p. 382.
Helicocranchia Massy 1909, p. 34.
Desmoteuthis (pars) Chun 1910, p. 302, 357.
Teuthowenia (*Helicocranchia*) Pfeffer 1912, p. 742, 750.

Body elongate, bag shaped. Fins small, oval; narrowed or even pedunculate at base; little or not at all united posteriorly. Eyes large, elevated on short stalks. Arms rather long, with two rows of suckers; no hooks. Funnel enormous, extending well past the head and eyes.

Type.—*Helicocranchia Pfefferi* Massy 1907 (monotypic); described from off the coast of Ireland.

Chun has referred this genus to *Desmoteuthis* (i. e., *Megalocranchia*), but it seems to me to be rather nearer to *Owenia* (*Teuthowenia* Chun), from which it differs most conspicuously in the more rounded eyes and enormous development of the funnel.

Helicocranchia species?

Cranchiid species, Berry 1909, p. 419 (mere locality record).

A single sadly dilapidated specimen of some cranchiid approaching very close to this genus was taken at *Albatross* station 4001, 230 to 277 fathoms, off Kapuai Point, Kauai [S. S. B. 261]. It is too fragmentary for satisfactory determination, but has been made the subject of the following notes:

Mantle much wrinkled and distorted; its outline in general elongate, swollen, cask-shaped; tapering behind to a point; anterior margin fused with head in the nuchal region and on either side of the funnel as usual in the group; width of mantle about a third the length. Fins very small, separate, delicate; attached for the anterior half of their inner margins to the minute and sharp membranous point which forms the posterior termination of the mantle.

Head small. Eyes moderately small, projecting forward upon very short club-shaped stalks. Funnel enormous, reaching far beyond the head and more conspicuous than any other structure in the anterior region of the body; heavy walled and inflated; aperture large.

Sessile arms very slender and delicate; the third pair much the longest, the second pair next in length, and the dorsal and ventral pairs very minute. Suckers small, but not in relation to the size of the arms; biserial; umbrella and swimming membranes absent.

Tentacles decollated; the stumps heavy, fleshy, brittle, without traces of suckers.

MEASUREMENTS OF HELICOCRANCHIA SPECIES?

	mm.		mm.
Length of mantle, dorsal	36	Length of dorsal arm	4
Width of mantle	11 ?	Second arm	9
Extreme length of fins	4	Third arm	11
Length of fins at base	2	Ventral arm	4
Width across fins	7	Funnel along medio-ventral line	[illegible]

The specimen is minus the major portion of both tentacles, the eyes and arms have become detached (although preserved in the bottle), and the remaining portions otherwise mutilated, so that it does not seem wise to attempt to attach any specific name, although a new species is undoubtedly represented. The great resemblance in general form to *Helicocranchia pfefferi* as described and figured by Miss Massy (1909, p. 34) is such that I have little hesitation in assuming that the present specimen is referable to the same genus, although the more broadly attached fins, lack of suckers on the stumps of the tentacles, and various minor details indicate that at any rate the two are not conspecific. If this identification be correct, the genus is now reported for the first time from the Pacific, the type species being known only from a single specimen dredged off the coast of Ireland. Were it not for the immense funnel the aspect would be almost that of an *Owenia*. The accompanying drawing is very unsatisfactory because of the difficulty and uncertainty pursuant to any endeavors to straighten out the wrinkled mantle and reconstruct fragmentary parts, but it seems worth while to offer it for whatever it may be worth. The mantle is probably not represented as sufficiently elongate, and the arms are considerably too short and stout.

LARVAL OEGOPSID.

An undetermined larval oegopsid of minute size is in the collection from *Albatross* station 3803, from a depth of 50 fathoms, between the Erben Bank and Kaiwi Channel [S. S. B. 387].

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TABLE IV.

STATIONS AT WHICH CEPHALOPODS WERE TAKEN DURING THE 1902 HAWAIIAN CRUISE OF THE "ALBATROSS", WITH AN INVENTORY OF THE SPECIES COLLECTED AT EACH.

Station number.	Locality.	Date (1902).	Depth.	Surface temperature.	Bottom temperature.	Character of bottom.	Species taken and number of specimens.
			Fathoms.	° *F.*	° *F.*		
3799	29° 22′ N., 139° 31′ W., between Erben Bank and Kaiwi Channel.	Mar. 18	Surface.	65	.....	.....	4 Tremoctopus violaceus.
3802	27° 4′ 15″ N., 144° 18′ 30″ W., between Erben Bank and Kaiwi Channel.	Mar. 20	150	.....	.....	.....	1 larval Octopod.
3803	25° 39′ 45″ N., 147° 41′ 45″ W., between Erben Bank and Kaiwi Channel.	Mar. 21	50	.....	.....	.....	1 larval Decapod.
3821	South coast of Oahu.....	Mar. 31	Surface.	76	.....	.....	1 Polypus β, 1 Euprymna scolopes.
3829	Off Avalu Point, Lanai....	Apr. 1	Surface.	75	.....	.....	1 Euprymna scolopes.
3832	South Coast of Oahu.....	Apr. 2	153–142	76	.....	Brown mud, sand.....	1 Stoloteuthis iris.
3837	South coast of Molokai.....	Apr. 3	Surface.	76	.....	.....	1 Polypus β.
3843	.....do.....	Apr. 4	Surface.	75	.....	.....	1 Polypus α.
3846	.....do.....	Apr. 8	Surface.	76	.....	.....	1 Euprymna scolopes.
3849	.....do.....	...do.....	Surface.	76	.....	.....	1 Polypus γ.
3856	Pailolo Channel between Maui and Molokai.	Apr. 9	127	74	66.5	Fine sand, yellow mud..	1 Euprymna scolopes, 1 Scæurgus patagiatus.
3857	.....do.....	...do.....	127–128	74	62.5	.....do.....	1 Argonauta sp., 1 Euprymna scolopes.
3858	.....do.....	...do.....	128–138	74	61.5	Fine sand, gray mud....	1 Scæurgus patagiatus.
3859	.....do.....	...do.....	138–140	74	60.2	Fine sand, mud.....	1 Euprymna scolopes.
3865	.....do.....	Apr. 10	256–283	76	45	Fine volcanic sand, rock.	1 Ommastrephes hawaiiensis.
3878	South of Lanai and west of Kahoolawe.	Apr. 14	Surface.	77	.....	.....	5 Tremoctopus violaceus, 7 Brachioteuthis riisei 2 Liocranchia globula.
3883	Pailolo Channel between Maui and Molokai.	Apr. 16	277–284	76	45.2	Globigerina ooze	1 Megalocranchia fisheri.
3889	North coast of Molokai.....	Apr. 17	Surface.	74	.....	.....	3 Euprymna scolopes, 2 Rhyncoteuthion α.
3896	Auau Channel between Maui and Lanai.	Apr. 29	126–130	74	63.1	Sand, pebbles, broken shells.	1 Euprymna scolopes.
3898	Pailolo Channel between Maui and Molokai.	...do.....	258–284	74	44.1	Brown globigerina mud, fine sand.	1 Laetmoteuthis lugubris.
3900	.....do.....	...do.....	283–280	75	43.9	....do.....	1 Heteroteuthis hawaiiensis.
3904	North coast of Molokai.....	Apr. 30	Surface.	75	.....	.....	1 Laetmoteuthis lugubris.
3905	.....do.....	..do.....	Surface.	75	.....	.....	2 Polypus β, 1 Polypus γ, 13 Euprymna scolopes.
3907	South coast of Oahu.....	May 5	Surface.	75	.....	.....	1 Polypus β.
3911	.....do.....	...do.....	Surface.	76	.....	.....	1 Polypus β.
3912	.....do.....	..do.....	Surface.	76	.....	.....	1 Polypus β, 1 Rhyncoteuthion α.
3921	.....do.....	May 6	Surface.	75	.....	.....	3 Polypus α, 2 Polypus β.
3926	21° 13′ N., 158° 43′ W., between Honolulu and Laysan.	May 10	Surface.	75	.....	.....	3 Tremoctopus violaceus, 1 Polypus β, 1 Euprymna scolopes, 1 Abraliopsis (juv.), 5 Rhyncoteuthion α.
3927	21° 31′ N., 161° 55′ W., between Honolulu and Laysan.	May 11	Surface.	76	.....	.....	1 Argonauta böttgeri.
3929	23° 19′ N., 166° 54′ W., between Honolulu and Laysan.	May 13	Surface.	75	.....	.....	1 Tremoctopus violaceus.

TABLE IV—Continued.

Stations at which Cephalopods were taken during the 1902 Hawaiian cruise of the "Albatross", with an inventory of the species collected at each—Continued.

Station number.	Locality.	Date (1902).	Depth.	Surface temperature.	Bottom temperature.	Character of bottom.	Species taken and number of specimens.
			Fathoms.	°*F.*	°*F.*		
3930	25° 07′ N., 170° 50′ W., between Honolulu and Laysan.	May 15	Surface.	74	.....	.....	3 Tremoctopus violaceus, 1 Polypus β, 1 Rhyncoteuthion β.
3931	25° 27′ N., 171° 08′ W., between Honolulu and Laysan.	...do.....	Surface.	74	.....	.....	2 Tremoctopus violaceus, 2 Euprymna scolopes.
3938	Vicinity of Laysan.....	May 16	148–163	76	60.3	White sand, broken shells.	1 Scæurgus patagiatus.
3980	Between Honolulu and Kauai.	June 9	Surface.	77	.....	.....	1 Polypus β, 9 Euprymna scolopes, 1 Rhyncoteuthion α.
3989	Vicinity of Kauai.....	June 11	733–385	78	37.5	Coral sand, rock.....	1 Heteroteuthis hawaiiensis, 1 Teleoteuthis compacta, 1 Mastigoteuthis (?) famelica.
4001	. do.	June 16	277–230	78	44.3	Coral sand.....	1 Helicocranchia sp.
4002	....do.	...do.....	230–53	78	47.1	Fine coral sand, globigerina, coral.	2 Polypus ε.
4009	Between Kauai and Oahu .	June 17	Surface.	76	.....	.....	1 Liocranchia globula.
4010	do	..do.....	Surface.	76	.....	.....	4 Tremoctopus violaceus, 5 Euprymna scolopes, 1 Rhyncoteuthion α.
4011	do.	.do.....	Surface.	77	.....	.....	7 Tremoctopus violaceus, 1 Polypus β.
	Honolulu Reef, Oahu.....	(?)	.....	.....	.....	.....	10 Polypus marmoratus, 3 Polypus ornatus, 1 Polypus β, 2 Euprymna scolopes.
	Honolulu market.....	(?)	.....	.....	.....	.....	1 Polypus sp., 1 Sepioteuthis arctipinnis, 2 Ommastrephes hawaiiensis.
4039	West coast of Hawaii.....	July 10–11.	670–697	76	38.7	Gray mud, foraminifera.	1 Eledonella (juv.).
4071	Northeast and north coast of Maui.	July 19	52–56	76	72.9	Fine coral, volcanic sand, foraminifera.	1 Euprymna scolopes.
4073	.....do.	...do.....	69–78	76	71.9	Coarse coral sand, foraminifera.	1 Euprymna scolopes.
4079	.... do.....	July 21	143–178	76	60.8	Gray sand, foraminifera.	1 Scæurgus patagiatus.
4082	.... do.	...do.....	220–238	76	48.8	Gray sand.....	1 Ommastrephes hawaiiensis.
4086	. ..do.....	..do.....	Surface.	76	.....	.....	2 Tremoctopus violaceus.
4087	Northeast approach to Pailolo Channel.	...do.....	308–306	76	43.6	Fine gray sand.....	1 Abralia trigonura.
4088	.....do.....	.. do.....	306–297	75	43.8	.....do.....	1 Heteroteuthis hawaiiensis.
4089	. .do.	...do.....	297–304	75	43.8	.....do.....	1 Heteroteuthis hawaiiensis.
4095	. .do	July 22	290–286	76	43.9	Brown mud, fine sand, globigerina.	1 Alloposus mollis.
4102	Pailolo Channel between Maui and Molokai.	July 23	122–132	79	.....	Fine gray sand, foraminifera.	3 Euprymna scolopes.
4103	.... do.	...do.....	132–141	78	61.7	Fine gray sand.....	3 Scæurgus patagiatus, 1 Euprymna scolopes.
4105	Kaiwi Channel between Molokai and Oahu.	July 24	314–335	76	43.8	Fine coral sand, foraminifera.	1 Pterygioteuthis microlampas.
4110	do ... . do.....		449–460	76	40.3	Gray sand.....	1 Polypus hoylei.
4117	Northwest coast of Oahu..	July 25	282–253	77	45.6	Coral sand, foraminifera.	1 Ommastrephes hawaiiensis.
4122	Southwest coast of Oahu...	July 26	192–352	79	64.6	Coarse coral sand, shells.	1 Abralia astrosticta.
4130	Vicinity of Kauai.....	Aug. 1	283–309	77	46.1	Fine gray sand.....	1 Polypus hoylei.
4132	....do.....	...do.....	257–312	77	46.8	Fine gray sand, mud....	1 Polypus hoylei, 1 Ommastrephes hawaiiensis.
4152	Vicinity of Modu Manu....	Aug. 5	Surface.	79	.....	.....	2 Euprymna scolopes, 1 Rhyncoteuthion α.
4153	....do.	...do....	Surface.	79	.....	.....	1 Euprymna scolopes.
4190	34° 39′ 18″ N., 132° 04′ W., between Honolulu and San Francisco, Cal.	Aug. 27.	Surface.	69	.....	.....	3 larval histioteuthids, 1 Brachioteuthis riisei.

EXPLANATION OF PLATES.

Except where otherwise stated in the context, all the drawings were prepared by Miss Lora Woodhead, of Stanford University. The photographs were made by J. H. Paine.

The numbers in brackets have reference to the author's register of examined specimens.

Plate XLV.

Polypus marmoratus, dorsal view of large male from Honolulu, ×⅞; [174]. Drawn by R. L. Hudson.

Plate XLVI.

Fig. 1. *Polypus ornatus*, dorsal view of a medium sized male from Honolulu, [179]. ×¾.

Fig. 2. *Polypus ornatus*, tip of hectocotylized arm of same specimen [179]; as yet not well developed, ×12.

Plate XLVII.

Fig. 1. *Polypus hoylei*, ventral view of male, type, ×¾; [166]. Drawn by R. L. Hudson.

Fig. 2. *Scæurgus patagiatus*, dorso-lateral view of male (type), ×1½; [204]. Drawn by R. L. Hudson.

Fig. 3. *Scæurgus patagiatus*, tip of hectocotylized arm of same specimen, ×2½; [204]. Drawn by R. L. Hudson.

Plate XLVIII.

Fig. 1. *Scæurgus patagiatus*, hectocotylized portion of left third arm of male (type), ×7; [204].

Fig. 2. *Polypus hoylei*, hectocotylized portion of right third arm of male (type), ×4; [166].

Fig. 3. *Polypus hoylei*, region surrounding right eye of same specimen, showing the supraocular cirri, considerably enlarged; [166].

Fig. 4. *Polypus hoylei*, funnel of male from the vicinity of Kauai, laid open along the medio-ventra line to show the funnel organ, ×2½; [176].

Fig. 5. *Argonauta böttgeri*, inner aspect of left second arm of female, ×2⅓; [165].

Fig. 6. *Polypus marmoratus*, hectocotylized portion of right third arm of large male from Honolulu, ×7; [174].

Fig. 7. *Polypus β*, left dorsal arm of small specimen from off the south coast of Oahu, ×5; [194].

Fig. 8. *Polypus β*, dorsal view of specimen from off the south coast of Oahu, considerably enlarged; [195].

Plate XLIX.

Fig. 1. *Lætmoteuthis lugubris*, lateral view of mandibles of specimen from the Pailolo Channel, nearly natural size; [212]. Drawn by J. H. Paine.

Fig. 2. *Lætmoteuthis lugubris*, apical view of same, same scale. Drawn by J. H. Paine.

Fig. 3. *Tremoctopus violaceus*, inner aspect of all arms of left side of female not quite adult, ×3; [221].

Fig. 4. *Tremoctopus violaceus*, funnel of same specimen laid open along medio-ventral line, ×4; [221].

Fig. 5. *Euprymna scolopes*, left tentacle club of male (type), inner aspect, greatly enlarged; [320].

Fig. 6. *Euprymna scolopes*, outer aspect of left dorsal arm of male (cotype) showing hectocotylization, much enlarged; [323]. The suckers of the innermost row along the basal portion of the arm are considerably larger than they should be in the figure.

Fig. 7. *Euprymna scolopes*, inner aspect of middle portion of same arm of same specimen, showing modified suckers, greatly enlarged; [323].

Fig. 8. *Euprymna scolopes*, right lateral arm of same specimen (several suckers missing from ventral row and not supplied in drawing), ×4; [323].

PLATE L.

Fig. 1. *Stoloteuthis iris*, dorsal view of type, ×3; [31]. Drawn by H. V. Poor.

Fig. 2. *Stoloteuthis iris*, tentacle club of type, inner aspect, greatly enlarged; [31].

Fig. 3. *Heteroteuthis hawaiiensis*, tentacle club of type (female), greatly enlarged; [30].

Fig. 4. *Heteroteuthis hawaiiensis*, large sucker from third arm of male from station 4088, greatly enlarged; [333].

Fig. 5. *Heteroteuthis hawaiiensis*, inner aspect of second right arm of type (female), ×4½; [30].

Fig. 6. *Heteroteuthis hawaiiensis*, photogenic organs of specimen from station 4089, ×2½; [333]. Drawn by J. H. Paine.

Fig. 7. *Heteroteuthis hawaiiensis*, lateral view of type (female), ×1¾; [30]. Drawn by H. V. Poor.

Fig. 8. *Heteroteuthis hawaiiensis*, ventral view of type (female), with mantle partially laid open to expose the locking cartilages and funnel, ×2; [30].

PLATE LI.

Fig. 1. *Abralia astrosticta*, ventral view of type (female), ×2; [171]. Drawn by H. V. Poor.

Fig. 2. *Abralia astrosticta*, inner aspect of right tentacle club of type, ×15; [171]. Drawn by H. V. Poor.

Fig. 3. *Abralia astrosticta*, ventral view of right eye of type and surrounding region, ×3; [171]. Drawn by H. V. Poor.

Fig. 4. *Abralia astrosticta*, dorsal view of type, ×1⅝; [171]. The extremities of the fins are represented as curved under, their true outline being more as indicated by the dotted line. Drawn by H. V. Poor.

Fig. 5. *Abralia astrosticta*, ventral aspect of funnel, showing the distribution of the photogenic organs, ×5; [171].

Fig. 6. *Abralia astrosticta*, fixing apparatus of left tentacle club of type, much enlarged; [171].

Fig. 7. *Abralia astrosticta*, lateral aspect of head and funnel of type, showing locking cartilage of left side of funnel, ×4; [171].

Fig. 8. *Abralia astrosticta*, funnel of type laid open medio-ventrally to expose the funnel organ, ×4; [171].

PLATE LII.

Fig. 1. *Pterygioteuthis microlampas*, ventral aspect of right eye of type and surrounding region, ×6; [277].

Fig. 2. *Pterygioteuthis microlampas*, funnel locking cartilage, much enlarged; [278].

Fig. 3. *Pterygioteuthis microlampas*, inner aspect of left tentacle club of type, much enlarged; [227]. Drawn by J. H. Paine, from a mount in balsam.

Fig. 4. *Toleoteuthis compacta*, inner aspect of left tentacle club of type, ×16; [238].

Fig. 5. *Toleoteuthis compacta*, inner aspect of right third arm of type, ×13; [238].

Fig. 6. *Mastigoteuthis* (?) *famelica*, ventral view of head of type, ×5; [260].

Fig. 7. *Mastigoteuthis* (?) *familica*, ventral arm of type, inner aspect, ×5; [260].

Fig. 8. *Mastigoteuthis* (?) *familica*, dorsal view of type, ×2½; [260]. Drawn by H. V. Poor.

PLATE LIII.

Fig. 1. *Rhyncoteuthion* α, dorsal view of well advanced specimen with free tentacles, from station 3926, ×2; [255].

Fig. 2. *Liocranchia globulus*, anterior (apical) portion of left latero-ventral series of tubercles, showing the small flanking tubercles (type), much enlarged; [262].

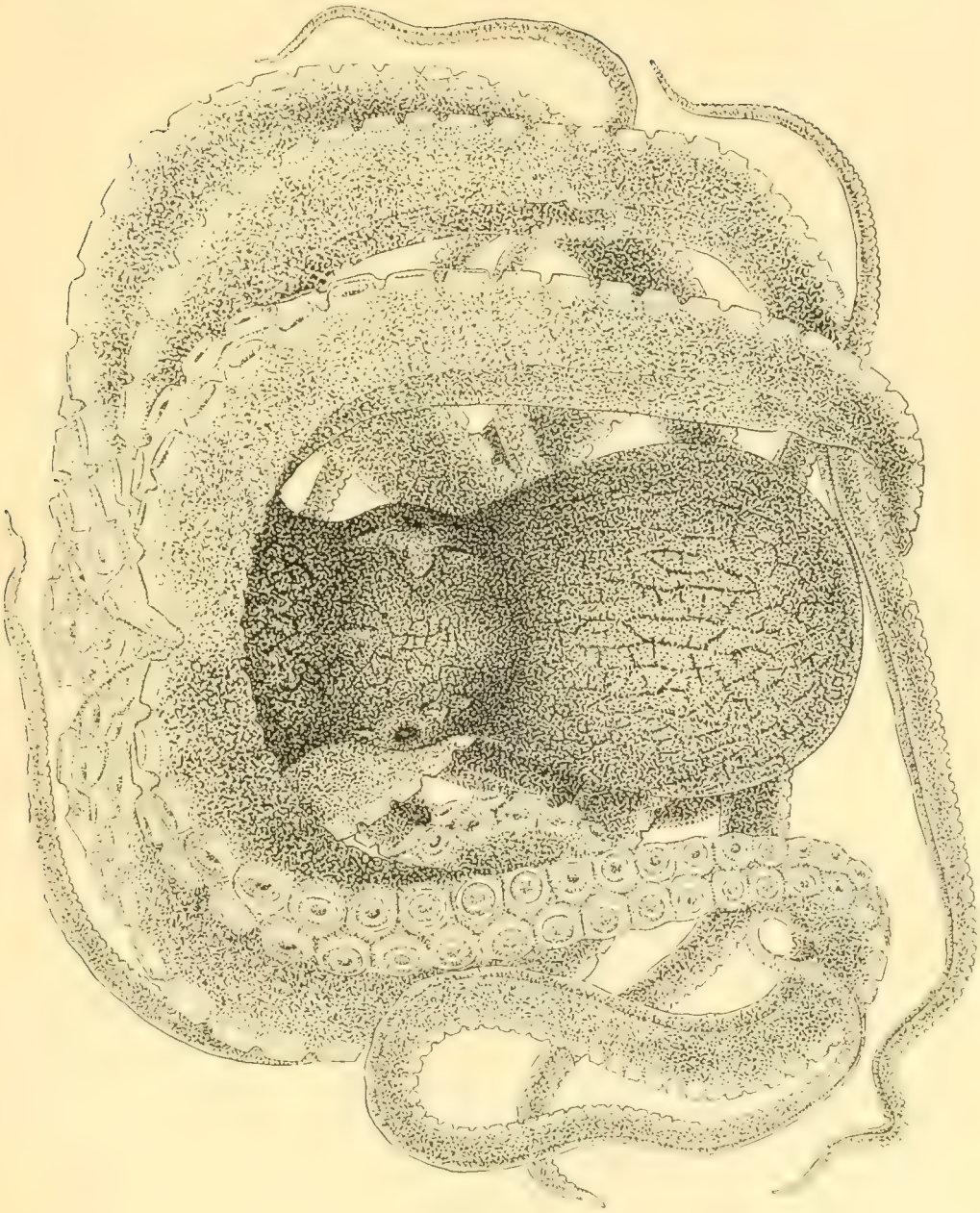
Fig. 3. *Liocranchia globulus*, tentacle of type, ×8; [262].
Fig. 4. *Liocranchia globulus*, dorsal view of type, ×2¾; [262]. Drawn by H. V. Poor.
Fig. 5. *Megalocranchia fisheri*, inner aspect of right tentacle club of type, ×4; [106].
Fig. 6. *Megalocranchia fisheri*, lateral aspect of same, ×4; [106].

PLATE LIV.

Fig. 1. *Sepioteuthis arctipinnis*, ventral view of male from market at Honolulu, ×½; [42]. Photograph.
Fig. 2. *Ommastrephes hawaiiensis*, inner aspect of right third arm of type, ×1⅔; [243]. Photograph.

PLATE LV.

Fig. 1. *Polypus hoylei*, inner aspect of arms and umbrella of type (male), ×½; [166]. Photograph.
Fig. 2. *Megalocranchia fisheri*, ventral view of type, ×1⅔; [106]. Photograph.



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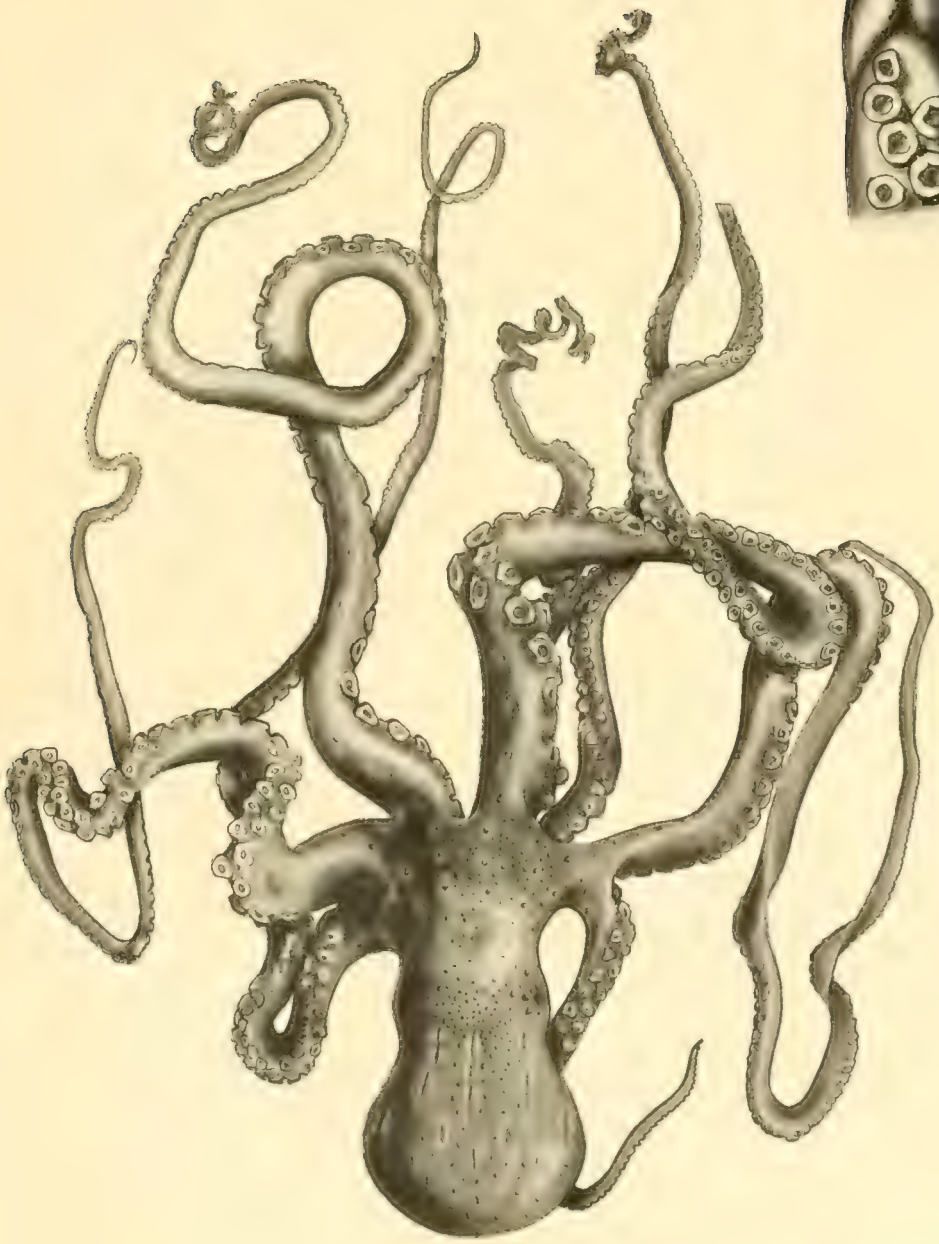

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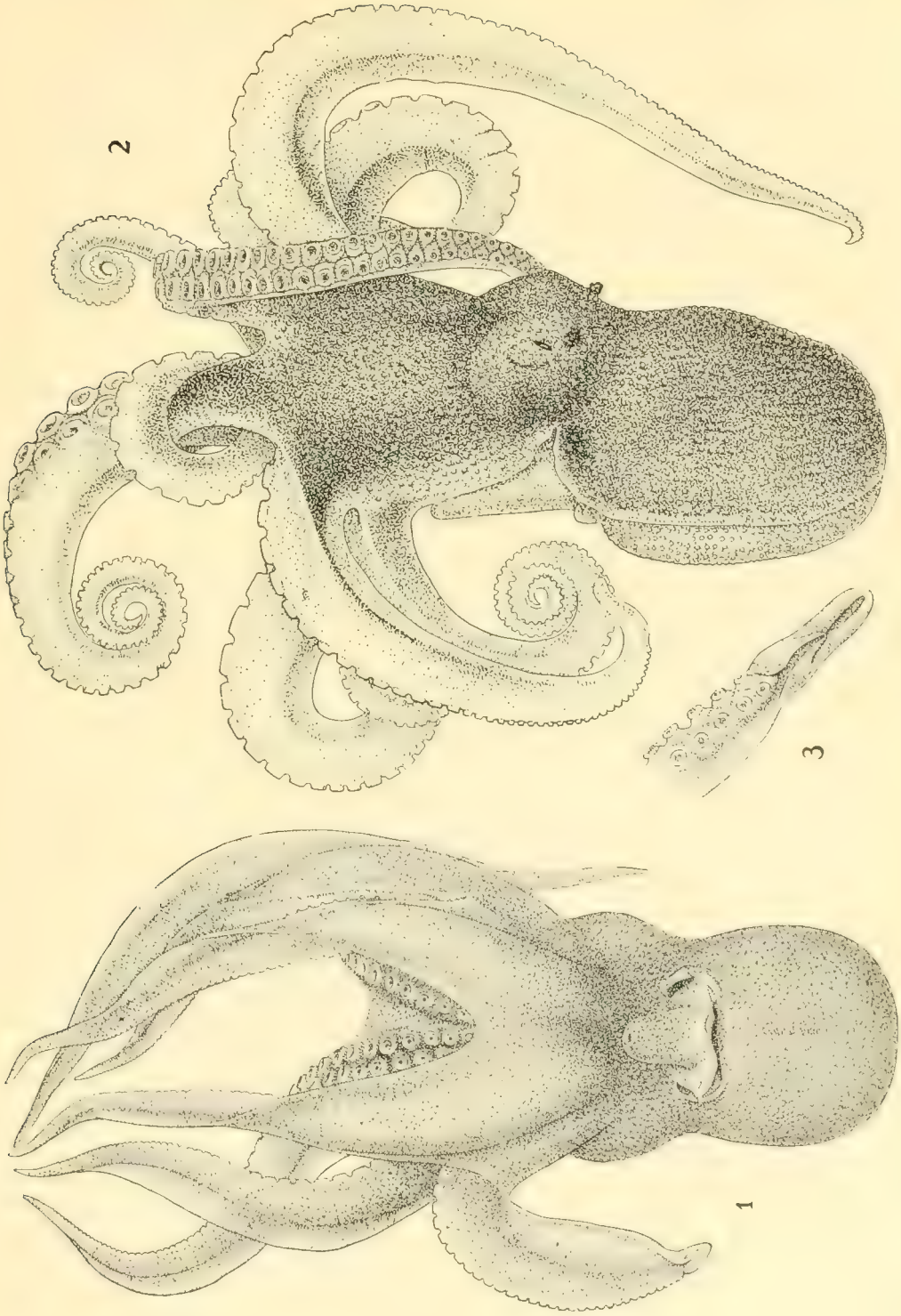
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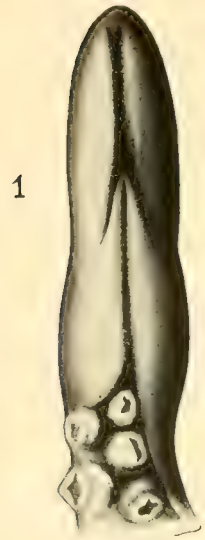
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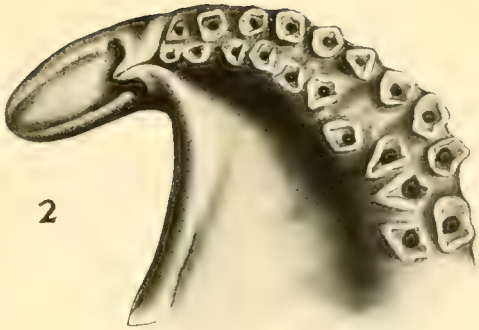
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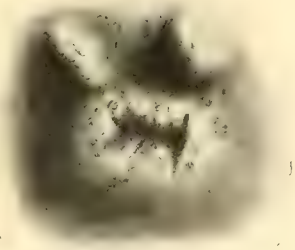
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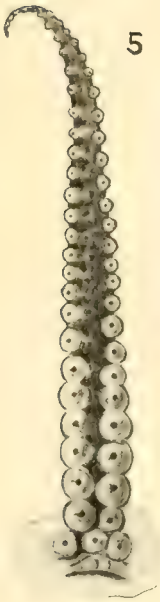
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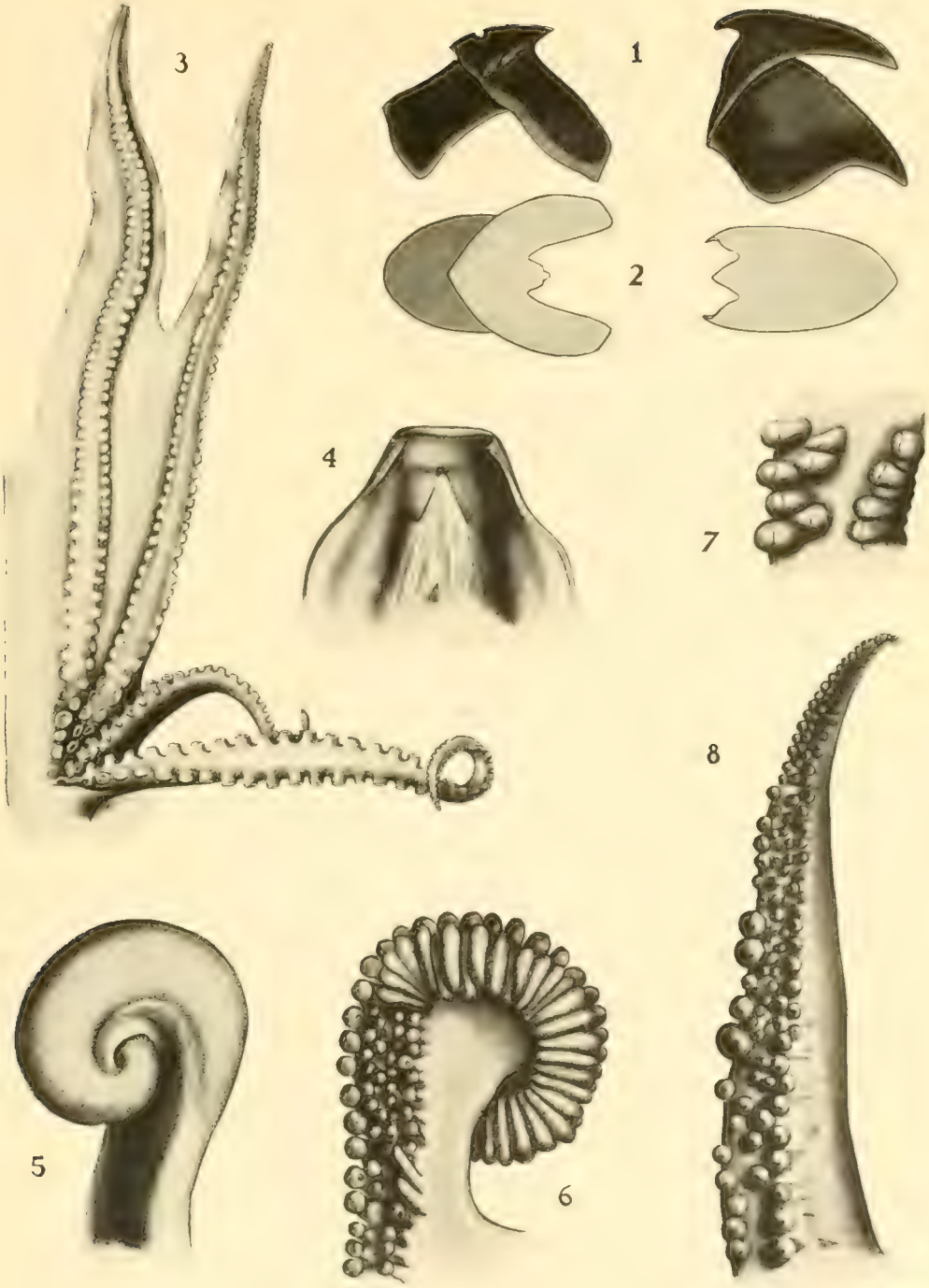
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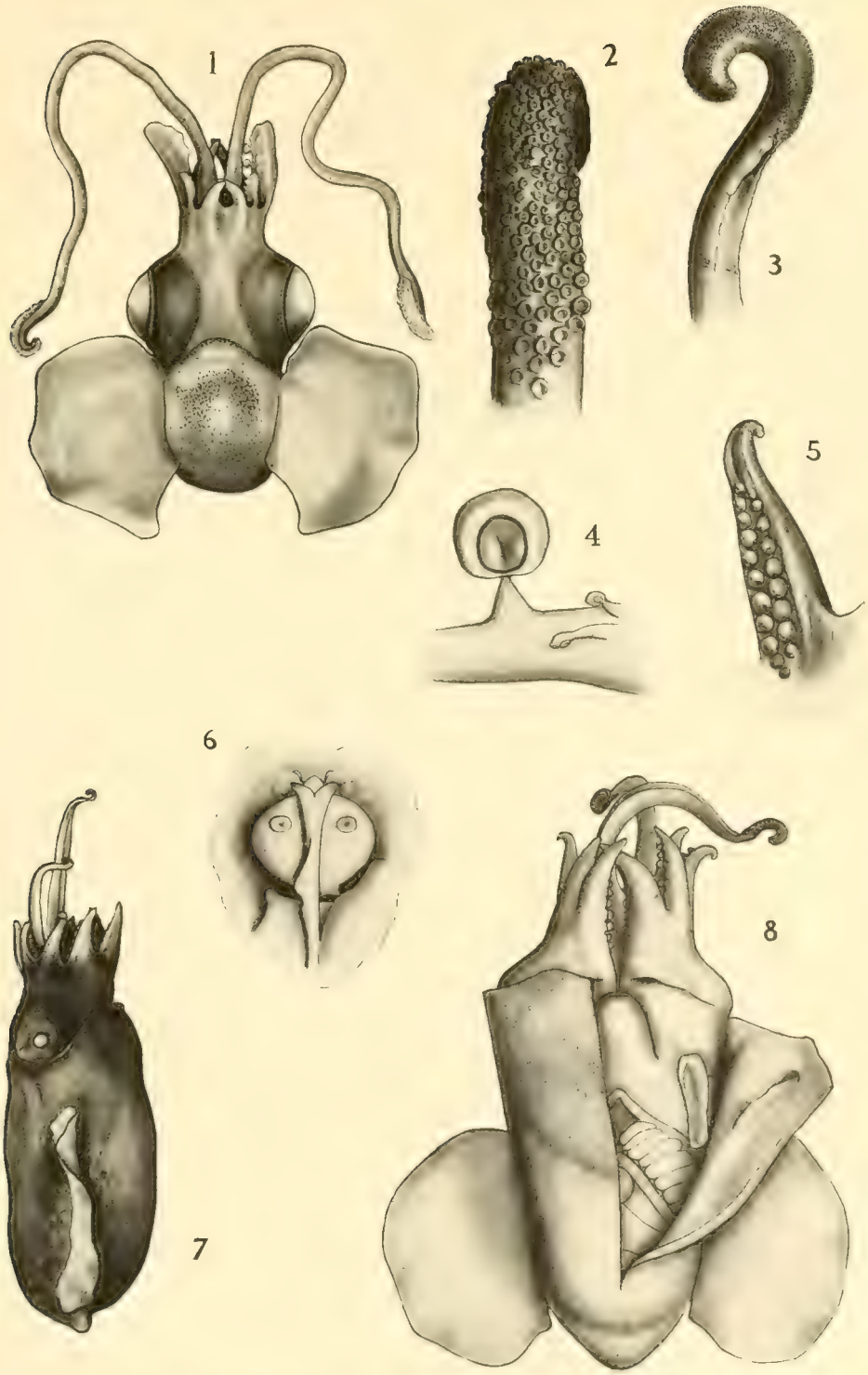
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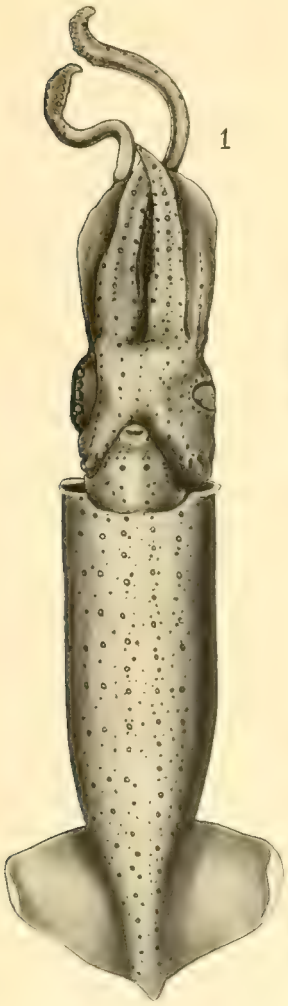
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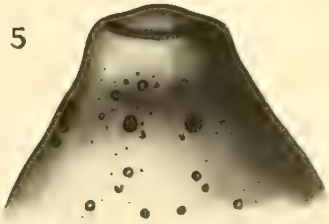
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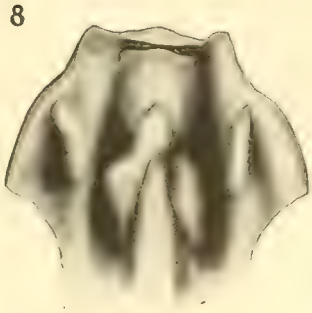
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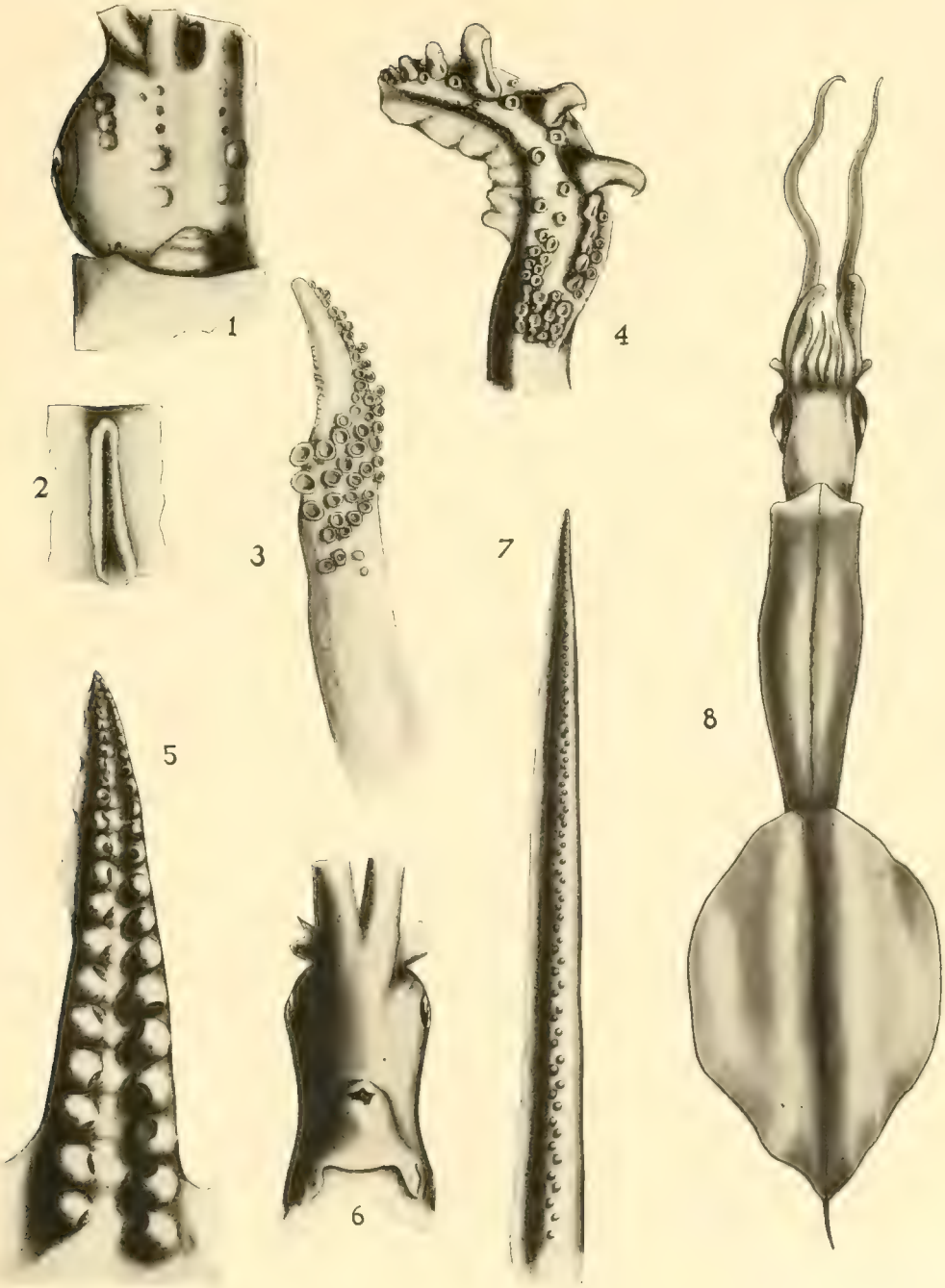
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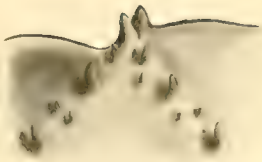

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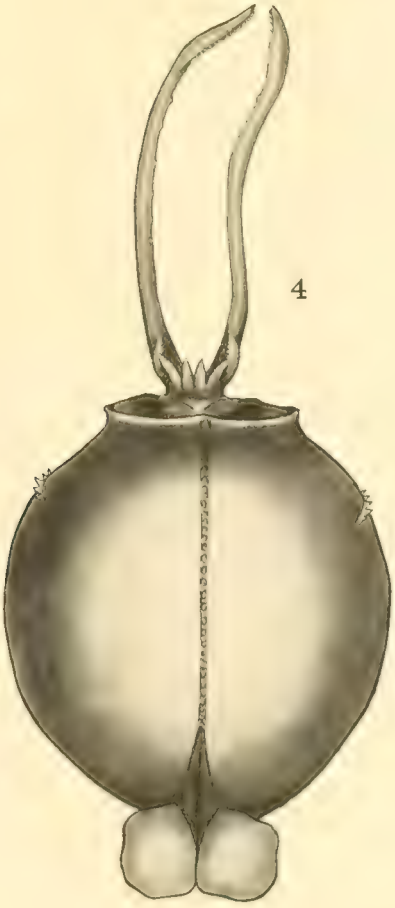

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